OFFICE OF INTERNATIONAL
AGRICULTURAL PROGRAMS
U.S. AID TITLE XII
STRENGTHENING GRANT

PROCEEDINGS OF KANSAS STATE UNIVERSITY'S 1981 FARMING SYSTEMS RESEARCH SYMPOSIUM-SMALL FARMS IN A CHANGING WORLD: PROSPECTS FOR THE EIGHTIES

Edited by
Wendy J. Sheppard

Paper No. 2 April, 1982

FARMING SYSTEMS RESEARCH

PAPER SERIES

KANSAS STATE UNIVERSITY
MANHATTAN, KANSAS 66506 U.S.A.

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FARMING SYSTEMS RESEARCH PAPER SERIES

Kansas State University's Farming Systems Research (FSR) Paper Series is supported by the U.S. Agency for International Development Title XII Strengthening Grant. The goal of the Strengthening Grant is to increase the University's capacity for, and focus its commitment to, implementing Title XII agricultural and nutritional development assistance programs in less-developed countries. This series is maintained by the FSR Program Associates—a multi-disciplinary team of professors who are focusing their activities around applied research on farming from a systems perspective.

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Vernon C. Larson
Director

Wendy J. Sheppard
Editor
International Agricultural Programs

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KANSAS STATE UNIVERSITY

SMALL FARMS IN A CHANGING WORLD:

PROSPECTS FOR THE EIGHTIES

NOVEMBER 11-13, 1981

FARMING SYSTEMS RESEARCH SYMPOSIUM

sponsored under the
Title XII Strengthening Grant

by the

Office of
International Agricultural Programs
Kansas State University
Manhattan, Kansas 66506

Symposium Planning Committee:

Charles Bussing	George Larson
Susan Casement	Vernon Larson
James Converse	David Norman
J. Arthur Hobbs	Wendy Sheppard
Berl Koch	L. Van Withee

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SYMPOSIUM OBJECTIVE

The Symposium focused on the problems and processes of small-scale agricultural development in the Third World and the United States. Dialogue was established by bringing together technical and social scientists who have studied the problems farmers face. By focusing on problems of the small farmer—using strategies such as farming systems research methodology, and development and delivery of appropriate technology—it is hoped that students, faculty, and practitioners gained a better global understanding, sensitivity, and awareness of the complex issues involved in agricultural development.

PREPARATION OF THE PROCEEDINGS

Each speaker provided a written manuscript of his presentation. The text of each manuscript was edited and modified to fit a standard form for layout, footnotes, tables and figures, and references. With a few exceptions, discussions and remarks by the panelists and other formal participants were taken from the written form, which they submitted after the Symposium. Those not submitted in written form were taken from the tape recordings of the Symposium; however, certain portions of these remarks have been omitted due to the intelligibility of some of the tapes (omissions indicated by an ellipsis); these include the following: Marvin Fausett (Session I Panel) and Charles Deyoe, Serrano Segundo, and John Dunbar (Session III Panel).

For the question and answer period after each session, questions that were submitted in writing (as requested at the beginning of the Symposium) were distributed to those individuals to whom they were directed. The names of the individuals who posed the questions (where available) and those who responded to the questions were included along with the texts of the questions and responses.

Wendy J. Sheppard
Editor

SYMPOSIUM AGENDA

WEDNESDAY, NOVEMBER 11

3:00-6:00 pm	Registration, 2nd Floor Lobby, K-State Union
7:30-9:00 pm	Reception, Flint Hills Room, K-State Union

THURSDAY, NOVEMBER 12

Little Theater, K-State Union
Vernon Larson, Presiding

8:00-8:30 am	Registration, 2nd Floor Lobby	
8:30-8:45 am	Welcome.....	KSU President Duane Acker
8:45-9:00 am	Conference Guidelines.....	Vernon Larson, Director International Agricultural Programs, KSU
		David Norman Agricultural Economist, KSU

SESSION I

SMALL FARMS IN THE THIRD WORLD AND U.S.

Vernon Larson, Chairing

9:00-10:00 am	"Small Farms in a Changing World".....	Glenn Johnson Agricultural Economist Michigan State University
10:00-10:30 am	Coffee Break, 2nd Floor Lobby	
10:30-11:00 am	"Small Farm Characteristics, Problems, and Programs in the Third World".....	Warren Vincent Agricultural Economist Michigan State University
11:00-11:30 am	"Small Farm Characteristics, Problems, and Programs in the U.S.".....	Jerry West Agricultural Economist University of Missouri
11:30-12:15 pm	Discussion	
	Panel:	Charles Bussing Geographer, KSU
		Marvin Fausett Extension Economist, KSU
		David Norman Agricultural Economist, KSU
	Questions	
12:15-1:30 pm	lunch	

SESSION II

FARMING SYSTEMS APPROACH—ADDRESSING PEOPLE'S NEEDS

James Converse, Chairing

1:30-2:00 pm	"Rationality of Farming Systems Practiced by Small Farmers".	Charles Francis Agronomist University of Nebraska
2:00-2:30 pm	"Farmer Participation in the Development Process".	Norman Uphoff, Director Rural Development Program Center for International Studies, Cornell University
2:30-3:00 pm	"Bridging the Gap Between Farmer and Research".	Edwin Price Agricultural Economist International Rice Research Institute, Philippines
3:00-3:30 pm	Coffee Break, 2nd Floor	
3:30-4:30 pm	Discussion	
	Panel:	Cornelia Flora Sociologist, KSU Berl Koch Animal Scientist, KSU L. Van Withee Agronomist, KSU
	Questions	
6:00-7:30 pm	Buffet Dinner, Ballroom, K-State Union	
7:30-9:00 pm	Slide Presentation	
	Introduction.	KSU Provost Owen Koeppe
	"Strategies for Small Farms".	Hugh Popenoe, Director International Programs University of Florida

FRIDAY, NOVEMBER 13

Little Theater, K-State Union
Vernon Larson, Presiding

SESSION III

DEVELOPMENT AND DELIVERY OF APPROPRIATE TECHNOLOGY

J. Arthur Hobbs, Chairing

8:00-8:30 am	"Relevant Technology Development and Transfer from Land-Grant Institutions".....	Floyd Smith, Executive Director Midamerica International Agricultural Consortium, KSU
8:30-9:00 am	"Relevant Technology Development and Dissemination from the International Agricultural Research Institutes".....	Robert McDowell Animal Scientist Cornell University
9:00-9:30 am	"Role, Potential, and Problems of Farming Systems Research and Extension: Developing Countries vs. United States".....	Peter Hildebrand Food and Resource Economist University of Florida
9:30-10:00 am	Coffee Break, 2nd Floor Lobby	
l0:00-11:15 am	Discussion	
	Panel:	Charles Deyoe, Head Grain Science and Industry Director, Food and Feed Grain Institute, KSU
		Jan Flora Sociologist, KSU
		Hugh Popenoe, Director International Programs University of Florida
		Serrano Segundo Ministry of Agriculture Philippines
		John Dunbar, Dean College of Agriculture, KSU
	Questions	
11:15-11:30 am	Wrap-up.....	Vernon Larson David Norman

WELCOME

Duane Acker, President, Kansas State University, Manhattan, KS:

We are delighted to have you here, especially for this topic. As President of this University, I'm exceedingly proud of the job that Vern Larson, Jim Jorns, and many, many of our staff are doing in the international arena. When I came to K-State, in 1975, I indicated that one of my goals for the University was to establish what I call an international posture—an attitude, an awareness, a presumption, if you please, that we live and work in an international arena, that our graduates will have the opportunity to live and work in other countries. If they don't do that, they'll at least travel in, or trade with, other countries, and if they don't do that, they'll find that the price of their wheat at Colby (Kansas) is going to be influenced as much by economic conditions in some other country as by the rainfall and climatic conditions in Thomas County. So, in all of our teaching and our research, I want us to just simply think internationally.

Your topic, small farming systems...back in about 1957, I helped teach an agriculture travel course. I was on the animal science faculty at Iowa State University—in corn and soybean country— where we took great pride in our big red and green tractors and a full line of equipment and heavy capital investment. We visited Kansas State in the Flint Hills; we visited Colorado and New Mexico. About two weeks out, we were on a small eighty acre farm just a few miles from Southwest Louisiana Institute—a small college. We were being hosted by a professor of agricultural economics who happened to own that small eighty acre farm. As we got off the Greyhound bus, these Iowa farm kids kind of smiled a little bit thinking "what is there to learn here?" The equipment on the farmstead...you probably could have put it on an Iowa farm sale and it would have brought less than $50—today it would bring more as antiques. One horse, one cow, one sow, and a pickup. He had three crops—three-year rotation, including cotton and sweet potatoes. He demonstrated how he dusted the cotton. He had a stick about this long, with half of a gunny sack tied on each end, and at the end of the field he had a sack of pesticide. He put a coffee tin in each one of the gunny sacks, and he shook the stick as he went down between two rows.

The owner showed us the financial statements. The return to labor and management was higher than the average Iowa farm income. Very few expenses. That sobered these Iowa kids—they were still thinking red and green, I suppose—but it opened their eyes, and it opened my eyes. I've seen this type of thing oft repeated to a greater degree. I've had the privilege of visiting and seeing some of the things that our staff have been doing in other countries. I know that many of you have seen this oft repeated, and you recognize that raising the level of living is really what we're after, whether we're in Kansas or Iowa or your state or Bangladesh or in Nigeria or in the Philippines... raising the level of living for human beings.

We hope you have a good conference, we're honored to have here. Thank you very, very much.

CONFERENCE GUIDELINES

Vernon Larson, Director, international Agricultural Programs, Kansas State University, Manhattan, KS:

Thank you President Acker... Let's look together at the objectives that have been established by our Symposium committee so that we might focus our thinking in the same direction, The Symposium will focus on the problems and processes of small-scale agricultural development in the Third World and the United States. Dialogue will be established by bringing together technical and social scientists who have studied the problems farmers face. By focusing on problems of the small farmer—using strategies such as farming systems research methodology, and development and delivery of appropriate technology—it is our hope that students, faculty, and practitioners will gain a better global understanding, sensitivity, and awareness of the complex issues involved in agricultural development.

You see that we have assembled a group of technical end social scientists who have devoted much time and expertise in studying the problems that farmers face. It is our hope that as we share together, we will gain a better understanding of this complex issue involved In agricultural development. Although much of the program appears to be focused toward the developing world, we want to tie equally into the problems faced by the small farmer in this country. We hope that you as speakers end you as discussants and all of us as an audience will also keep that in mind,

SMALL FARMS IN A CHANGING WORLD

Glenn L. Johnson
Professor
Department of Agricultural Economics
Michigan State University
East Lansing, MI 48824

Introduction and Objectives

There is an increasing, widespread interest in the small farms of the world. In the United States, agricultural scholars, agricultural fundamentalists, various activists, and agricultural economists are concerned about small farms. Internationally, developmental scholars recognize the numerical importance of small farms and of the people who live on them. Poverty is widespread on the small farms of the less developed world and serious attempts to improve the lot of man, vis-a-vis nutrition and general welfare, must address the multitudinous problems of small farms and poor farmers around the world.

Not all small farms are problems and not all farmers farming small farms are poor. When we want to refer to problematic small farms, it is probably better to use the term "poor, limited-resource farms." In the United States, there has been a great decrease in the number of poor, limited-resource farms while the proportion of small farms (farms incapable of providing full-time employment for a family) has increased. United States agriculture increasingly displays a bimodal distribution of farm sizes. We have many fewer farms overall, an increasing number of large farms, a decreasing number of middle-sized farms, and an increasing proportion of small farms—the latter being part-time farms for the most part. Many formerly middle-sized farms have either expanded to become larger ones or have disappeared to be consolidated with other farms as a result of off-farm migration of their operators or their operators' children. Most of the middle-sized farms that have disappeared had resources too limited to permit their operators to keep up (even with price and service subsidies) with the increased incomes available elsewhere. The operators and their families either had to accept an income disadvantage, expand in size, or they or their children had to seek off-farm employment. Present-day colleges of agriculture, many businesses, many, government agencies, many high-paying industrial labor jobs, and many educational and church positions are occupied by the children of operators of former middle-sized farms while many of the operators themselves went to the cemetery. Generally speaking, the children of former middle-sized farmers are not landless laborers as in the less developed world. Part-time farming on what were previously regarded as middle-sized farms has increased in areas where off-farm employment is available and where the farms can be restructured around enterprises compatible with off-farm employment. This maintains the proportion and tends

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*A contribution under Project 442, Michigan Agricultural Experiment Station. Help and valuable assistance is acknowledged from Sri Ramaratnam and his type B Master's paper entitled "An Overview of the Holistic Farm Management Research and Extension Programs with Emphasis on Past U.S. Farm and Home Programs and Current Farming Systems Research in the Developing Countries," and from Judith Brown, Ralph Hepp, Karl Wright, Eric Crawford, Carl Eicher, David Rohrback, and Beverly Fleisher, not all of whom agree with all aspects of this paper as presented here.

to increase the numbers of what are now regarded as small farmers with limited farming resources; however, a high proportion of farmers on such farms are not poor. Off-farm employment in areas of small farms has been increased with public projects, e.g., TVA in the Southeast, and as a result of interstate migration of labor-intensive industries. Some alarmists and activists see, in the above-described developments, a conspiracy among large-scale farmers, the agricultural land-grant establishment, and large agribusinesses or transnationals to drive small farmers out of farm employment to become unemployed, landless laborers. This view, often expressed or implied by writers such as Perelman (1978), Lappe and Collins (1979), and George (1976), seems quite inconsistent with the history of American agriculture. A few years ago, we decried the tendency of some to see a "communist conspiracy" in all situations; now, activists seem to see "fascist" or "capitalist" conspiracies at least as often (Nelson, 1980).

Abroad, small farms have been reduced in numbers largely in the centrally controlled economies which have restructured their agricultural economies to concentrate land ownership or control in large state and/or "cooperative" farms. Outside of the centrally controlled economies, several land reforms have been carried out which have increased the number of small farms. Only a few of these reforms have been reversed. The more successful reforms in market controlled economies (such as in Taiwan, Japan, and South Korea) are now experiencing pressure to subsidize small farmers or to enlarge the maximum size of farms to permit per capita incomes of farm peoples to keep up with the increased income of non-farm persons. In effect, farms previously thought to be large enough under the land reform schemes have become poor, limited-resource farms in a manner analogous to the situation that developed in the United States. In much of the less developed world where land reforms have not been carried out, agricultural policies have been so adverse that large off-farm migrations to urban slums have occurred, but farm consolidation has not been profitable, Thus, the problem of poor, limited-resource farms is widespread in the less developed world.

In Europe and Japan, and also in the United States where limited-resource farms have been subsidized and given price advantages, costs to taxpayers and consumers have been excessive. In the United States, production controls have often subsidized small farmers through the device of "minimum acreage allotments" and price supports (Johnson, 1952a). Most U.S. acreage allotments have been eliminated in recent years, the main exceptions now being the peanut and tobacco programs. Direct subsidies and indirect price subsidies to keep limited-resource farms from being poor are expensive alternatives to larger farms and off-farm migration or unsubsidized part-time farms. Americans, as taxpayers and consumers, and their European counterparts are less and less willing to pay the price.

Abroad, the current interest in small farms grows, in part, out of the rediscovery of agriculture by general developmental economists and rediscovery of farm management by agricultural development economists and administrators. Earlier, the general economist's interest in development underemphasized agriculture, e.g., early Soviet, Indian, Thai, and South Korean plans. Also in those early years, agriculture development economists were mainly policy oriented. Eventually both general economists and agricultural economists concerned with development realized that agricultural development proceeds through the decisions of individual farm managers—most of whom were in the private sector—notwithstanding some attempts to establish state and cooperatively operated farms (Millikan and Hapgood, 1967).

With the above by way of introduction and justification, the objectives of this paper are:

1. To summarize important developments in the history of farm management thought, in order to provide historical perspective for current farm management researchers, advisors, and extension workers.
2. To summarize the history of development thought with respect to agricultural economics and farm management, with stress on difficulties arising from (a) lack of familiarity with farm management literature and thought and (b) failure to integrate farm management, local planning, and national planning approaches.
3. To briefly examine activist thought vis-a-vis small farms.
4. To examine farming systems (FS) research in the Centers for International Agricultural Research (ICARs) in the light of (1) and (2) above and with attention to its relationships in less developed countries to (a) central and local planning, (b) extension work, (c) university level farm management research and teaching, and (d) national research systems.
5. To reach some conclusions on researching reforms and equity questions vis-a-vis limited-resource farms.

Important Developments in the History of Farm Management Thought

In the early part of this century in both the United States and Europe, technical agricultural scientists were driven by their experiences and logic to create farm management as a field of study. Soil scientists, crop specialists, dairy, beef, and swine husbandrymen, etc., were eventually forced to consider the interrelationships among the enterprises found on farms.

The technical scientists who, for the most part, became the first farm management professors in the United States and in Europe were oriented to the biological and technical sciences. They knew little economic theory and tended to neglect research on the normative and prescriptive, due, in part, to the positivism they brought from their biological and physical science backgrounds. They took it for granted that more income for farmers was good and that farmers would know how to transform more income into a better life. However, they recognized the sociological dimensions of farm management. Most departments of rural sociology in the United States originated with a single sociologist hired by a chairman of a department of farm management who felt the need for a sociological understanding of the activities of farmers.

At Cornell University, in particular, farm management researchers became concerned with policy and the constraints placed on the managers of actual farms by the malfunctioning national economy of the ’20s and ’30s.

John D. Black, at the University of Minnesota in the 1920s, is probably the person to credit (or blame) most for introducing production economics into farm management (Black, et al., 1947). (Spillman (1933) was important in a more specialized way.) Black’s efforts were not altogether popular at Minnesota. General economists and disciplinarians recognized his efforts, however, and he was given a chair in agricultural economics at Harvard University where he continued to "preach the Gospel." At Harvard, he produced a large number of students (including agricultural extension workers), many of whom were not as effective as he was in making a place for production economics

in farm management. While the introduction of production economics into farm management greatly strengthened part of its theoretical structure, it also tended to make farm management less multidisciplinary, thereby weakening other parts. Since the late 1950s, much of modern U.S. farm management has looked more and more like a sub-field of production economics, which is itself a part of economics without the multidisciplinary breadth required to handle the problems which arise for farm managers out of technical, institutional, and human change (Johnson, 1957, 1959, 1963). Fortunately, the production economists never succeeded in fully dominating farm management; a substantial core of farm management scholars in the United States have maintained substantial interest in technical and lesser interest in institutional and human change.

It is worthwhile noting that the production economists who dominated the North Central Farm Management Committee of the United States for many years, starting about 1950, found it necessary to engage in macroeconomics and policy analyses in order to research many important farm management problems. In this respect, they were like their earlier farm management counterparts.

T.W. Schultz published an article before World War II (Schultz, 1939) in which he criticized John D. Black and the production economists, as well as the earlier more positivistic, technically-oriented farm management men, for being too static in their viewpoints. Schultz pointed out that there had been little change in the farm management research programs as the country has gone through the upheavals of the depression; the introduction of production, price, and acreage controls; and a general restructuring of society under the New Deal. Schultz drew heavily on Knight's Risk, Uncertainty and Profit (1921) and advocated attention to risk-bearing and the role of management in the presence of imperfect knowledge and foresight of technological, institutional, and human changes. The impacts of his criticisms materialized in the 1950s and are discussed later in this paper.

In the immediate post-World War II years, farm management workers and agriculturalists at the University of Missouri became impressed with the interrelationships among the various components of a farm, including those between the firm and household. Albert Hagan, with the support of O.R. Johnson (then chairman of the Department of Agricultural Economics), played a prominent role in establishing The Missouri Balanced Farming (BF) Program (Hagen, 1980 and undated). It reinforced the emphasis of traditional farm management on the technical aspects of farming by developing a college-wide program in which the technical and biological scientists could freely participate. Balanced farming, however, also reached out in the social science direction to the home economists and sociologists. The program can be faulted a little, perhaps, for relative underemphasis on the social sciences and home economics, but must be given substantial credit for doing better in this regard than earlier extension programs and much better than the newer blend of farm management and static production economics in which farm management tended to go its separate way more or less independently of home economics.

In the Missouri BF Program, there was a substantial commendable interest in the allocation of income and investments between the firm and home components of a farm. The work at Missouri had substance and realism; it was applied—not abstract and theoretical. Also, much that was done in the BF Programs was more or less consistent with the implications of Knight's risk and uncertainty theory, which Schultz had recommended be used more widely in farm management. In the dynamic economics developed and implied by Knight, the distinction between profit maximization by the firm and utility maximization by the

household disappears as it is necessary to maximize non-monetary values in optimizing the performance of managerial functions for firms as well as households.

The Missouri BF Program attracted the attention of farm management extension and research personnel at the University of Kentucky. They, too, were dealing with large numbers of limited resource, poor farmers. University of Kentucky College of Agriculture administrators and farm management extension personnel created the Kentucky Farm and Home Development (FHD) Program (Welch, 1954; Young, 1948; Kentucky Farm and Home Development Program, undated; Cooperative Extension Service, 1955). This program, like the Missouri BF Program, drew on the resources of the entire College of Agriculture, but placed a greater emphasis on the interrelationships between the firm and household within a farm. There was little direct emphasis on dynamic managerial principles despite the great logical consistency between a FHD program, on one hand, and the dynamic managerial principles, on the other, which the North Central Farm Management Research Committee was then inheriting, in part, from Frank Knight and further developing on its own (Johnson, 1952).

In the 1950s, at least some of the leaders in the North Central Farm Management Research Committee took T.W. Schultz's 1939 admonition seriously and began to pay more attention to the ideas of Frank Knight. Bradford and Johnson's farm management text (1953) provided an integrated view of the home and business components of a farm largely as a result of dealing with dynamic managerial processes. The Bradford/Johnson view was based on Knight's theory, the Missouri BF Program, and Kentucky's FHD Program. After considerable discussion, preliminary empirical work, and the publication of two bulletins (Johnson, 1954; Johnson and Haver, 1953) attempting to develop the implications for farm management of the works of Frank Knight, Albert Hart, Abram Wald, and others, members of the North Central Farm Management Research Committee launched a large-scale, very empirical interstate study of the managerial processes of 1,065 midwestern farmers commonly referred to as the Interstate Managerial Study (IMS) (Johnson, et al., 1961). This study was a continuation of earlier smaller-scale empirical research at the University of Kentucky. The IMS investigated a large number of hypotheses having to do with the managerial process with a survey of 1,075 farmers in eight Midwestern states. While the IMS can be faulted in many respects, it is probably the largest empirical study of managerial processes ever conducted. It was based, in major part, on the theoretical ideas of Frank Knight (1921) and Abram Wald (1947), as well as those of vonNeumann and Morgenstern (1947) as expressed by Friedman and Savage (1948) in their article on the utility analysis of choices involving risk. Conceptually, the study was ahead of farm management thought among extension workers, including even that reflected in the BF Program of Missouri and Kentucky's FHD Program.

The IMS study clearly revealed the importance of utility maximization on the part of firm managers and, hence, the futility of distinguishing between the profit maximization activities of firms and the utility maximization of households. It also revealed a great deal about learning as an aspect of management, the sources of information used by farm managers, and the kinds of information that they acquire, as well as how they analyze information. It confirms, and places even greater emphasis on, the multidisciplinary nature of, farm management than did the traditional farm management of the '20s and '30s. It also expanded Knight's risk, certainty, and uncertainty definitions. Further, it provided substantial empirical evidence confirming the importance of the Friedman/Savage analysis of insuring and gambling, which is now referred to as the "expected utility hypothesis."

The Kentucky FHD Program was regarded as successful by Kentucky and federal extension administrators and, along with the Missouri BF Program, became the basis for the inauguration of a National FHD Program by the federal office of the Cooperative Agricultural Extension Service. This program met with a mixed reception in various states; most states, however, made at least some attempt to add a home dimension to their farm management programs, but not all were successful. In some cases, the programs did not attain college-wide acceptance, in part because the program tended to be the responsibility of the agricultural economics department, which made the mistake of confining the program to its own turf. This was conceptually unwise because farm management is multidisciplinary and cannot be confined to economics (Johnson, 1957, 1959), and politically unwise as it solidified political opposition in the other departments of the colleges of agriculture.

Farm management scholars interested in incorporating static production economics theory into farm management were also somewhat unreceptive to the multidisciplinary nature of the FHD idea. So were many of the more traditional farm management men who had important clientele groups of large-scale farmers, who were interested in a brand of farm management that emphasized production technologies from the biological and physical sciences uncluttered with firm/household interrelationships. Home economists and rural sociologists were strong supporters of the National FHD Program, as it offered them important, but different, roles.

The National FHD Extension Program did not persist for long, though there are still substantial residuals of it, particularly in Missouri and Kentucky, The rural sociologists who evaluated various farm and home development programs were enthusiastic in their endorsement of it (Ramsey, 1951; Sargent, 1960; Slocum, 1962; Slocum and Brough, 1962; Strauss, 1958), but that is probably due, in some part, to the recognition it gave their work.

The IMS referred to above offers <u>one</u> hypothesis as to why the FHD Program disappeared. Those programs emphasized reorganization rather than operation of farms. An IMS analysis of the informational content of FHD extension materials indicated that their content rather closely approximated the pattern of information used by farmers in reorganizing, but not in operating, farms (Johnson, <u>et al.,</u> 1961, p. 38). There is no evidence that the informational content of the FHD Program was ever reoriented to operation so that the FHD programs could continue to serve their clientele even after reorganization.

A second hypothesis explaining the demise of FHD is that commercial farms have productive enterprises large enough to justify separate farm management and home programs with integration of the two left to the competent farm families on such farms. Also, the competition between consumption and production investments is not as keen on large, well-to-do farms as on the smaller, poorer farms of the mid-South. Thus, the FHD Program may have had a less crucial function to play for commercial farmers of the Corn Belt and West than for poor, limited-resource farmers of the South.

A <u>third</u> hypothesis to explain the demise of farm and home development is the faddishness of agriculturalists, including State extension personnel and USDA administrators. The FHD Program was followed with an emphasis on rural community development which diverted extension resources from FHD efforts.

A <u>fourth</u> hypothesis is that FHD would have had a more permanent impact had intellectual undergirding which T.W. Schultz (1939) called for, and

which the IMS (Johnson, et al., 1961) later provided, been available in its formative period (Johnson, 1952b).

The work of George Dantzig, Tjallings Koopmans, and others on linear programming began to have its impact on academic farm management about when FHD diminished in importance in the late '50s and early '60s. Though linear programming was being developed and was used to solve practical logistical problems during World War II, it did not attract significant favorable attention in farm management until after Fred Waugh published his article in the Journal of Farm Economics entitled "The Minimum Cost Dairy Feed" (1951). To some, even that application seemed mundane, in view of the exciting things going on in the BF and FHD extension programs and in research on managerial processes.

In any event, the increased availability of computers, computer software, and courses to train agricultural economists and farm managers in linear programming and other computer techniques led to an important blossoming of computerized farm management research and extension in the '60s and '70s. Much of this important work was and is based on close cooperation with the biological and physical scientists of the colleges of agriculture who help generate coefficients for linear programs. Except for greater explicit use of maximization, the resultant pattern of computerized research is similar to that of earlier traditional non-computerized farm management research. Unfortunately, it reflects little interest in farm/household interrelationships, probably because it is so difficult to develop a common denominator of the various monetary and non-monetary values important in dynamic firm/household management to use as an objective function (Johnson, 1960). Also, little attention is paid to the dynamic, managerial principles advocated by T.W. Schultz and studied so extensively by participants in the IMS.

Somewhat parallel to the extensive use of linear programming and simulation models in farm management has been the interest in expected utility analysis referred to above. Some variants of expected utility analysis are combined with portfolio analysis in studying agricultural credit, capital and investment problems. There has been a reestablishment of interest in agricultural capital and credit in recent years, which also tends to neglect the interrelationship between firm and household as well as much of the dynamic managerial theory considered in the IMS.

The Friedman/Savage utility analysis of choices involving risk presumed risk neutrality on the part of a decision-maker (Friedman and Savage, 1948). Their analysis demonstrated that a risk neutral decision-maker can logically both insure and gamble at unfair odds, provided he maximizes utility and that the shape of his utility function is appropriate, but so could risk adverse and preferring individuals. Friedman and Savage did not address the question of how to incorporate risk aversion and preference in their analysis. While what is now known as "expected utility analysis" has advanced beyond the Friedman/Savage analysis, it has not made significant progress on handling risk preference and risk aversion as viewed by Friedman. The typical expected utility analysis does not deal with risk aversion in the sense of a decision-maker valuing a given outcome less (once attained) because risk was involved in attaining it—as when a soldier who survives a shelling gets sick and vomits despite the fact that he is physically unscathed. Similarly, the typical expected utility analysis does not deal with risk preference in the sense that a decision-maker would value any given outcome greater if attained under uncertainty than if attained under certainty as, for instance, when the risk of combat proves exhilarating and enjoyable to a different risk preferring

soldier. Some managers enjoy, and are stimulated by, risk—others are sickened and depressed by i t. Current expected utility analysts would classify the same decision-maker as risk adverse when he insures at unfair odds and as risk preferring when he gambles at unfair odds. In the expected utility analyses, each alternative possible outcome, once attained, has a utility which is invariant with respect to the degree of risk associated with attaining it (Friedman and Savage, 1948, pp. 291, 299, 303). Current expected utility analyses confuse (a) special shapes of utility functions which ignore risk with (b) risk aversion and preference as discussed above. One result of this confusion is the conclusion that most farmers are risk adverse because they express a willingness to insure at unfair odds against crop failure and other disasters if the almost universal tendency to gamble means anything empirically. It indicates that these same farmers would probably take chances at unfair odds for substantial gains, an indication substantiated by IMS empirical research results (Johnson, et al., 1961).

Important conceptual and practical results have resulted from risk analyses of investment "portfolios." These results combine with current extensions of asset fixity (preferably investment/disinvestment) theory (Robinson and Abkin, forthcoming; Baquet, forthcoming) to produce the promise of more productive analysis of farm growth, stagnation, or decline than presented elsewhere by this author (Johnson, 1965, 1977).

The land-grant universities are currently criticized by some for having been too responsive to farmers' need for technological change and by others for being unresponsive. Activists and critics of the agricultural establishment accuse the land-grant system of creating technologies so well-adapted to the needs of larger farmers that they were able to use these technologies to drive the smaller farms out of existence.

On the other hand, some (notably the farming systems analysts in the ICARs) imply that they are unique in researching "farmer adapted technology." However questionable the assertions of the activists and critics are (see the introduction of this paper for a much more acceptable alternative explanation of what happened to U.S. small- and medium-sized farms), the evidence is clear that the land-grant universities have been responsive to farmer needs and have long produced "farmer adapted" technologies. A farm management researcher, Ray Hoglund, in our Michigan State University department, attained state and national renown for his attention to the technological needs of dairy farmers and for his evaluation of new technological developments. Farm management workers in other states have done the same. A research example is the study in our department using Mexican nationals to pick pickles (Stuckman, 1959; Johnson and Zerby, 1973, Ch. 6). In that study, it became apparent that laborers to pick pickles would not be available for long at wages that would permit pickles to be priced competitively with other commodities. Therefore, the agricultural economists and horticulturalists participating in the pickle study strongly endorsed research on a mechanical pickle picker which was successfully developed. Similar needs for mechanical pickers were also apparent in the case of cherries, blueberries, raspberries, and strawberries. Mechanical pickers for cherries and blueberries have been developed, and Michigan still has thriving cherry and blueberry industries. Efforts for strawberries have not been successful, and Michigan has lost much of that product along with the strawberry picking jobs. It should also be noted that the much maligned tomato-picker does not work well under the humid non-irrigated production conditions of Michigan and that we lost our tomato industry to states where the tomato picker is "farm adapted." The stress of farming

system analysts on farmer adapted technology in the ICARs is, thus, a commendable continuation of a longstanding procedure in the land-grant colleges and universities rather than something new.

The Thinking of Development Economists with Respect to Agriculture

This main section looks briefly at the thinking of general developmental economists, vis-a-vis agriculture, in order to see the need for farm management by central planning agencies and vice versa, as well as the difficulties inherent in integrating the two.

Following the success of the Marshall Plan, the developed countries attempted to help launch many of the less developed countries on the road to economic development. At first, the general economists who helped in this effort tended to neglect agriculture. They regarded agriculture as a lagging sector—as more of a burden then an asset—and as a repository for unemployed and underemployed labor that could be transferred to the non-farm sector at no loss in agricultural productivity. Agriculture was also regarded as a source of capital and income to divert to much more productive activities. However, many schemes to extract labor income and capital from agriculture were destructive of agricultural productivity and ineffectual in transferring capital and manpower. Few, if any, of the plans and schemes (whether Indian, Pakistani, Ghanaian, Argentinian, or Burmese) were as effective as the reliance of the United States on inheritance to off-farm migrants, education of farm people, and enough price and income support for agriculture to permit savings and education of farm children. The general economists were suffering from lack of knowledge about agriculture and how it operates.

Eventually, it became evident that the agrarian sector of largely agrarian economies had to be developed in order for overall economic growth to occur (Eicher and Witt, 1964, p. 8; Millikan and Hapgood, 1967). Only with additional income could large rural populations (a) become profitable markets for the products of urban industry and benefit from development while (b) providing the capital and trained labor to develop the non-farm sector (Johnson, et al., 1969, pp. 1-7). Thus, the general development economists rediscovered agriculture. Unfortunately, few general economists had the background, agricultural knowledge, and training to understand what they saw. General economists needed to heed the admonition to "know what they saw instead of seeing what they knew" with respect to agriculture. T.W. Schultz, Bruce Johnston, William Nichols, and Kazushi Ohkawa were some of the outstanding exceptions as they were both agricultural and general economists (Eicher and Witt, 1964).

The agricultural development economists of that era tended to know more about what was to be seen in agriculture than the general economists; however, they knew little about farm management—some even reflected a distaste and impatience with it. Eicher and Witt's 1964 book of readings on agriculture in economic development does not contain a single chapter on farm management, the possible exception being a chapter by Kahan on Russia's collective farm system. Some felt that an interest in policy and in development was at a broader plane superior to that of the "grubbers of dirt" who dealt with the details of the management problems of unimportant, uneducated peasants. Just as general development economists had to rediscover agriculture, many agricultural development economists had to rediscover farm management.

When the agricultural development economists rediscovered farm management, many of them—like their general development economist counterparts—did not

understand very clearly what they saw. They, too, seemed to "see what they knew," and they did not know much farm management. They were not used to paying attention to the micro details of individual farm businesses. They neglected the rich historical experiences of farm management researchers and extension workers in the United States, and European farm management researchers, much as the general economists neglected the literature of agricultural economics (see Eicher and Witt for an absence of references to farm management literature, BF, FHD, and studies of dynamic managerial processes).

Conceptualizations by development economists (both general and agricultural) about the role of agriculture in development tended to start out from general economics rather than from the rich history of farm management and agricultural economics research and extension, which had long had a primary concern with the development of agriculture. There has been much reinventing of the wheel in developmental thought as general developmental economists and agricultural development economists have discovered farms, and governmental and research institute administrators have rediscovered farm management. Lessons gleanable from the historical development of the field of farm management and agricultural economics have been neglected by members of these groups as indicated by the selective nature of their bibliographies (Norman, 1980; Whyte, 1981; Mellor, 1966, pp. 16-17, 154-155). There are few citations of the literature generated by the International Association of Agricultural Economists or by several decades of farm management researchers in Europe. Even the prestigious Social Science Research Council's study of farm management published prior to World War II is rarely mentioned. Similarly, Schultz's seminal 1939 article (Schultz, 1939), which served to introduce Frank Knight's risk and uncertainty theory (Knight, 1921) into farm management, is seldom cited, nor are the important empirical investigations of managerial processes conducted by the North Central Farm Management Research Committee of the United States (Johnson, et al., 1961).

At more macro levels, the general economists concerned with agrarian economies used "dual economy modes" extensively in abstract macroanalyses of development. Less developed country (LDC) economies were viewed as consisting of a modern or modernizing sector and a traditional stagnant sector, the latter being mainly agrarian. Such models often regarded agrarian labor as having zero marginal productivity. These simplistic models were used to address problems of how to transfer labor, capital, and income from the traditional sector to develop the modern (industrial) sector.

General economists used the concept of "marketable surplus" to recognize the interdependence between the production and consumption activities of small farms in the less developed world which had been stressed earlier at Missouri and Kentucky. Unfortunately, this recognition was abstract and macro without the realistic substantive content of the Missouri BF and Kentucky FHD programs.

Also, abstract micromodels of farms were developed involving two components, one for the firm and one for the household. These simplistic abstract models of complex phenomena were manipulated and experimented with in attempts to understand how the activities of farmers affect generation of the marketable surpluses needed to support development. Again, one knowledgeable of the much less abstract, empirically richer research of U.S. agricultural economists and farm management researchers, and of the programs of the U.S. state agricultural extension services, cannot help but be struck by the poverty of these efforts to conceptualize the activities of farm producers and consumers.

Early post-World War II thought with respect to development planning placed heavy emphasis on formulating periodic central plans concentrating on the non-farm sector. This early imbalance in development thought led to something of an overcorrection, which brought "community development" into vogue. The result was local planning without prerequisite national policies and programs, on one hand, and the neglect of farm technology and the production of goods, services, and income to support community projects, on the other. Consequently, community planning did not fare well for long and was followed, particularly in AID and World Bank circles; with renewed attention to central planning, including, this time, sectoral analysis. Unfortunately, balance was not attained in this reaction either. The reemphasis on central planning and a new emphasis on "sector analysis" (including agricultural sector analysis) neglected both rural communities and farm management. Overreaction was followed by a countervailing overreaction, and the cycle continued. Attention to central planning and sector analysis soon gave way to a reincarnation of community development called rural development. In AID, rural development became dominant while sector analysis and central planning were nearly abandoned except in various program planning offices of AID/Washington and U.S. AID missions abroad. While this cycling was going on, AID lost most of its technical expertise in the field of general agriculture, farm management, and agricultural economics. Consequently, rural development was no better balanced than community development was earlier with respect to farm management, firm/household interrelationships, and production technology. The real tragedy of all the cycling and overcompensating imbalance was the failure to attain an appropriate mix of (a) production technology, (b) central government planning with respect to institutional change and human capital development, and (c) assistance to the firm/household complexes or farms (particularly poor, limited-resource ones) in agriculture.

The agricultural economists in ICARs should probably not be expected to improve farm management research and extension in national LDC governments and LDC universities. Undoubtedly, the need is great, but ICARs budgets for agricultural economics and farm management are limited. For the time being, at least, it seems more important to improve farm management and/or FS research and outreach in the ICARs by placing additional emphasis on firm/household interrelationships, values, "true" risk aversion and preference, induced institutional and human change, managerial processes, and what knowledge can be contributed to national planners about the micro-impacts of alternative farm development schemes and policy changes needed to expedite agricultural production.

Limited-Resource Farmers and Activists' Positions and the Need for Objective Research on Reforms and Equity

The basic problem of small, limited-resource farms is that they do not own enough productive rights and privileges to generate the income needed to transform the basic needs of their families into effective demand. T.W. Schultz and his associates have shown that peasant farmers typically use the resources they have efficiently. This provides empirical justification for concluding that they would also use additional resources effectively. Among the resources that can be produced by, and/or redistributed to, them are improved technology (through reform of research and extension systems), general and vocational education (through reform of educational systems), self-generated capital (through policy reforms to shift the terms of exchange in favor of limited-resource farmers), credit (through agricultural credit reform), land (through land tenure reform), and capital grants (through government). All of these alternatives to direct income assistance rather permanently increase the incomes

of recipients instead of merely meeting their current needs.

Various activists, some of whom originally knew, and still know, little about agriculture, have taken up the banner for small farms and for poor, limited-resource farmers. There is an exchange of sympathy between some of the new (since the late '60s) activists and agricultural fundamentalists. The latter group includes many rural people and urban nostalgic off-farm migrants and many of their descendants. Information from agricultural fundamentalists suffers from (a) the poor selective memories of off-farm migrants and their descendants, i.e., they forget the bad characteristics of farming and farm life that caused them or their ancestors to leave farming, and (b) the temptations of those still on farms to bias information for their own political and economic advantage. Information from the activists suffers from (a) their lack of agricultural experiences, and (b) their, strong commitment to advocacy of courses of action prior to careful study of underlying normative and positive knowledge about agriculture. While the activists do not neglect the normative, they do not investigate it well either; instead, they rather typically write tracts that attempt to impose (propagate) the values and prescriptions of disillusioned, middle class "liberal" urbanites on farm people and agricultural leaders often in a manner quite inconsistent with (a) the concerns of 19th century liberals with individual freedom, and (b) the reality of the environments of poor, limited-resource farmers. Simply stated, the writings emanating from the coalition of activists and agrarian fundamentalists lack scholarly objectivity. However, the writings and speeches of activists are important. They—and publicity they attain—are molders and shapers of public opinion. Serious students of small farms and scholars concerned with the plight of poor, limited-resource farmers cannot ignore the writings and activities of this coalition. Objective scholars, as always, bear the burden of trying to keep the intellectual record straight. With this responsibility, they cannot ignore the pronouncements of the activists.

Much objective scholarly research has been done on land reform, the generation and distribution of agricultural technology and education reform, agricultural credit reform, and shifting of the terms of exchanges in favor of limited-resource farmers. Less research has been done on direct capital grants. However, the efforts of such reforms on equity have not been carefully researched. As a result, it is difficult to determine if activists' assertions with respect to equity are correct or incorrect. Further and more importantly, the lack of such research makes it difficult to know which attainable equity objectives should be targeted.

Farm management scholars have a substantial potential contribution to make to objective study of equity for limited-resource farmers. Such research involves predicting the production and consumption responses of farmers to such reforms. It also involves research on the non-monetary as well as monetary values involved, a subject increasingly susceptible to objective research (Johnson and Brown, 1980; Johnson, 1978).

Farming Systems Research in the Centers for International Agricultural Research

The ICARs are the products of a group of biological and physical agricultural scientists operating since 1941 with a deep commitment to improve agricultural technology, In the early days, the Rockefeller Foundation was the major supporter of this approach.

Later in its early days, AID also had a large staff of technical agriculturalists—so did the Ford Foundation. Both AID and the Ford Foundation stressed extension activities to transfer American agricultural production know-how abroad, as well as forms of community development. Unlike the ICARs, they did not stress research on new, country-specific technology or, for that matter, research on institutional and human change. In the conflicts between advocates of central and local planning discussed earlier, AID lost most of its technical agriculturalists, including much of what little farm management expertise it had, while the Ford Foundation shifted its financial support and hiring policies away from agricultural extension, community development, and public administration to overall budget support of technical research in the ICARs. The Agency for International Development and donor agencies of other countries followed with budgetary support as well.

The ICARs originated in a period in Latin America (the very early 1940s) when, and where, concern with social problems and research on redistribution of resource ownership or income was sufficient to make any research institute an "institute non-grata." The quiet contribution of the ICARs of country-specific agricultural technology developed and flowered outside of the cycles in the thought and activities of development specialists discussed above. Since the early ‘40s, social and political conditions have changed around the world and institutes may now become non-grata for failing to give attention to income and resource ownership distributions through institutional change and the development of human resources. However, very little attention is given in the ICARs to the land and other socioeconomic reforms necessary to give poor, limited-resource farmers in the LDCs more resources (land, capital, and education, as well as technology) to permit them to develop their farms.

While the ICARs continue to be concerned primarily with improving agricultural technology, they and their supporting agencies have introduced agricultural economics and farm management into their agendas. At the time the decision was made to introduce agricultural economists into the ICARs, arguments were heard at a meeting of the Ford and Rockefeller Foundation representatives in New York and at a conference at Bellagia attended by this author as to the advisability of doing macroagricultural policy, trade, institutional marketing, and human development research in the institutes. Some of those favoring research on policy issues argued that poor policies often interfere with the adoption of otherwise advantageous agricultural technologies. Similarly, it was argued that trade and marketing problems for both products and inputs often interfere with the full utilization of the technologies being generated in the ICARs. Probably due to the large costs which would have been involved in introducing a full-scale agricultural economics and social science research program in the various ICARs, the objectives sought in introducing agricultural economics into the ICARs appear to have been (a) to better organize the accumulation of data and information to demonstrate the effectiveness of the ICAR’s biological and technical programs, and (b) to help put technological research programs into perspective, vis-a-vis the needs of the farms that use the technologies generated by the ICARs.

Thus, agricultural economics in the ICARs has been oriented to the <u>applied</u> interests of the biological and physical scientists who dominate the ICARs. Vernon Ruttan’s experience and contributions at IRRI preceded and paralleled those of Winkelman at the International Maize and Wheat Improvement Center (CIMMYT), Flynn at the International Institute for Tropical Agriculture (IITA), and those of Binswanger, Byerlee, Dillon, and others. Vernon Ruttan’s earlier forays into policy (largely agriculture science policy) are not now matched in

the ICAR. Agricultural economics at the ICARs has now focused on farm management—more specifically on FS research and research designed to help guide the biological and physical scientists to produce "farmer-adapted technologies" for use in the LDCs.

There is a fairly close parallel between the FS research as it has developed in the last decade (largely in the ICARs) and the traditional farm management research which emerged in the United States in the 1920s and '30s (National Academy of Sciences, 1974; Gilbert, Norman, and Winch, 1980; Norman, 1978, 1980a, 1980b); both are oriented to the biological and physical sciences and, hence, technology. The production economists working on FS research are better trained than their earlier more traditional farm management counterparts in terms of theory and quantitative techniques, and they have access to computer facilities—in short, they have disciplinary excellence. However, what is, and can be, done is constrained by the physical and biological science administrators of the ICARs and their positivistic research philosophies (Johnson, 1980). Despite the attention of development economists (both general and agricultural) to marketable surpluses, dual economies, and the production/consumption interrelationships on small farms, ICAR farming systems research tends to neglect the relationships between the firm and the household components of small farms. Also, agricultural economics in the ICARs differs from traditional farm management with and without production economics, both of which became involved in the interrelationships between farm management and policy as discussed earlier in the paper, while FS research has not done so, at least to the same extent.

Farming systems research is portrayed by ICAR agricultural economists as holistic because it looks at the interrelationships between different crops grown, and between various supporting systems of a farm and the production of its main commodities. In this sense, it is a much more holistic approach than that of a plant breeder, plant protectionist, or soil scientist (Collinson, 1972). However, it is not as holistic as the FHD program that was developed at Kentucky and later nationalized, or the still earlier BF Program in Missouri, Those programs gave relatively more, but still inadequate, attention to institutional and human change than FS research; further, they placed greater stress on firm/household interrelationships.

Farming systems researchers at the ICARs have devoted considerable attention to the analysis of risk in analyzing the productive activities of farm businesses. In this connection, there has been unwise interpretation of the results of "expected utility analysis." This difficulty Involved the "perversion of risk and uncertainty analysis" referred to in an earlier subsection of this paper. Risk preference and aversion is an extremely important subject influencing the adoption or rejection of new technologies and new institutions, as well as investments in human capital. The influences cannot be adequately handled by an analysis that treats all insuring decisions at unfair odds as risk averse and all gambling decisions at unfair odds as risk preferring, all under the implied assumption that the utility of an attained outcome once attained is independent of the risk involved in attaining it (Friedman and Savage, 1948, pp. 291, 299, 303). Farming Research in the ICARs needs an expected utility analysis that does not make this assumption in order to handle risk preference and aversion. Also, much more attention needs to be given to the economics of performing ail six of the managerial processes: problem definition, observation, analysis, all aspects of decision-making, execution, and responsibility bearing.

University of Chicago economists have effectively utilized the concepts

of induced technological and institutional change along with the economics of human capital to explain, predict, and analyze technical, institutional, and human change (Schultz, 1963; Becker, 1962; Hayami and Ruttan, 1971). There can be little doubt as to the success of this effort. However, the neglect by technologists, institutionalists and social scientists, educators, and psychologists of the market in generating technical, institutional, and human change does not mean that the role of the market economics of these three kinds of changes is all that is needed. While economists using market concepts have been successful in explaining and predicting some heretofore unexplained technological, institutional, and human phenomena, it seems clear that there is much more to explaining technical, institutional, and human change than can be explained with the economics of the market. Farming systems research seems to accept the idea of induced technological change, even though FS research is, itself, a non-market activity that supplements the market to guide technological agricultural change into channels appropriate for farmers. Farming systems research, however, has done little with the ideas of induced institutional change and the "new home economics" with its emphasis on the formation of human capital and the utilization of female labor in the production activities of the household as well as the firm.

"The markets" which induce institutional and human change like those for technical change seem to be quite imperfect and in need of suplementation with non-market activities, such as those of FS researchers on farmer-adapted technologies. Farming systems research on institutional and human change would help bring about "farmer-adapted" institutional changes and "farmer-adapted" programs for creating human capital. Perhaps attention might even be given to the creation of "home-adapted household technologies" vis-a-vis food preparation, human nutrition, sanitation, and disease prevention. Such research would help release constraints on the use of females for more productive pursuits than found in primitive household/firms. Such changes in the ICAR's farming systems research agendas would make FS research become more holistic with attention to (a) the household as well as the firm <u>and</u> (b) institutional and human change.

The ICAR’s farming systems researchers have not done significant research on reform, other than with respect to agricultural science and technology. Equity has received little attention even with respect to technology. The ICARs do have stated objectives of helping small farmers, but, even so, the main stress is on improving technology to expand food production, not equity. Because of their limited research budgets and because their specialty is agricultural technology, it does not seem advisable to advocate that FS researchers in the ICARs take responsibility for research on the reforms necessary to attain productivity and equity for the world’s poor, limited-resource farmers.

<u>Potential Contribution of Farm Management Research on Equity. Problems of Limited-Resource Farmers</u>

The conclusion that ICAR’s farming systems researchers should not be responsible for studying equity and reform questions, concerning poor, limited-resource farmers does not mean that farm management researchers should not be responsible for researching such questions. Farm management scholars have knowledge and techniques for estimating the production consumption and equity impacts of alternative reform measures. Still further, their ability to work with and know farm people expedites their acquisition of normative knowledge, a crucial component of prescriptive research on alternative reform proposals. Pragmatism, a philosophy that undergirds institutional economics and the

philosophic demise of logical positivism, makes it possible to once again conceive of objective research on the normative and of objective non-Pareto better solutions to reform problems (Johnson and Brawn, 1980).

Summary, and Conclusions

I. Examination of the history of farm management thought indicated that:

A. A technical orientation for farm management is necessary, but not sufficient—institutional and human orientations are also necessary.

B. The business and household components of farms are closely related, especially on small, limited-resource farms. Even on large commercial farms, utility, as well as profit maximization, is important, which obscures the firm/household distinction.

C. Non-monetary values are important in farm management—in addition to the non-monetary values involving workmanship, pride, family members, survivability, old age, security, etc., farm management researchers

1. transform monetary into non-monetary values when using the expected utility hypothesis to study chance-taking and insuring activities of farmers, and

2. study the non-monetary values important in the optimizations that farm managers carry out while performing managerial processes.

D. Farm management is rather holistic and multidisciplinary, which means that neither economics nor a subpart of economics, such as production economics, can provide an adequate intellectual base for farm management scholars.

E. Computer technology is of increasing importance to both farm management scholars and managers of farms.

F. Historically, various groups of farm management scholars have found it advisable to research the interrelationships among the

1. management of individual farms,

2. macro-impacts of decisions by individual farms, and

3. impacts of government (both national and local) on individual farms.

G. Expected utility analysts have not adequately addressed the subjects of

1. risk preference and aversion, and

2. the economics of managerial processes.

H. Substantial theoretical advances are being made in investment/disinvestment theory for use in explaining farm size, as well as growth, stagnation, and decline.

I. Farming systems researchers in the ICARs have been having substantial success in introducing techniques to help biological and physical scientists produce "farmer-adapted" technologies. These technicians are working as well in the ICARs as they have long done in the U.S. land-grant system. However, induced institutional change and the formation of human capital are neglected at the farm level.

J. Little attention has been given to land and socioeconomic reform as a means of increasing resources at the disposal of limited-resource farmers.

II. Examination of development thought of general and agricultural economists has been hampered in national and local planning efforts by lack of knowledge about farm conditions and the saving, investment, production, and consumption responses of individual farmers. Attempts to remedy this situation have often involved use of unrealistic abstracts, conceptions, and models. More reference to the rich literature of farm management and better use of farm management scholars is a means of partially correcting this situation.

III. The writings and policies of many activists concerning small farms hardly qualify as objective and scholarly; nonetheless, their writings and speeches are widely disseminated and influence public thinking. Researchers, extension workers, farm and non-farm leaders, and policy-makers should be concerned about the inaccurate, slanted content of many activist tracts about small farms. This concern is appropriately expressed by:

A. Serving in advisory capacities for such groups as opportunities arise.

B. Reviewing such writings in professional journals, extension meetings, seminars, and conferences such as the present one.

C. Inviting such writers to present seminars.

D. Speaking out in meetings where such ideas and conclusions are presented.

E. Doing objective research on reforms and equity vis-a-vis limited-resource-farms (see V below).

IV. Conclusions about needed changes of directions in:

A. Farming systems research on small farms in the ICARs. This research should be:

1. examined in the light of

a. the history of literature of the Missouri BF and the Kentucky/National FHD programs;

b. the history and literature of the grafting of <u>static but not dynamic</u> production economics onto the traditional variety of farm management, which had dominated from the early 1920s through World War II to avoid undue disciplinary specialization;

c. theories of induced
i. institutional change,
ii. human capital formation, and
iii. technological, and

d. other theories of, and ideas about,
i. institutional change from sociology and political science,
ii. changes in people from the behavioral sciences, and
iii. technological change—its causes, prediction, and assessment.

2. examined in the light of policy constraints on improving the lot of the poor, limited-resource farmers among small farms, vis-a-vis

a. programs and projects affecting prices (output and input, including credit), access to inputs, infrastructure, and

b. redistributive programs (reforms).

3. expanded to include more attention to

a. firm/household interrelationships;

b. dynamic managerial processes and principles, i.e., on managerial processes as opposed to applications of the expected utility analysis;

c. the redefining of risk aversion and preference; and

d. recent developments in investment/disinvestment theories.

B. At the same time, domestic research on small farms should be:

1. examined to see where the current emphases on computerized accounting, linear programming, expected utility analysis, and mini-computer software packages for making various decisions has led to neglect of

a. managerial processes and

b. firm/household interrelationships.

Do this without loss of emphasis on necessary competing activities.

2. in addition, domestic research on small farms should be examined and expanded along the lines suggested above for FS research in the ICARs (also see V below).

V. Farm management should join with macroanalysts and welfare economists in researching reforms to improve the welfare and productivity of the world's poor, limited-resource farmers.

A. Reforms that should be researched involve

1. national and international agencies and markets for generating and distributing new agricultural technologies;

2. educational systems for generating human capital;

3. policies and institutions influencing the terms of exchange for poor farms;

4. land tenure;

5. capital grants;

6. agricultural credit.

B. The generation of normative as well as positive knowledge is required in researching reform and equity questions. To generate such knowledge will require many farm management researchers to

1. utilize the pragmatic methods and techniques of institutional economists.

2. reject the now defunct constraints of logical positivism (including Pareto-optimality and conditional normativism).

3. return to the more normative techniques of classical and neo-classical economics for studying-non-monetary as well as monetary values and welfare.

VI. In order for farm management researchers to make their full contribution to solving the problems of limited-resource farmers abroad, it would be helpful if such international and unilateral donor agencies such as AID would stop cycling in their emphasis on national planning, project development and evaluation, and execution at the <u>national</u> level, on one hand, <u>vs</u> local and micro-levels, on the other.

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SMALL FARM CHARACTERISTICS, PROBLEMS, AND PROGRAMS IN THE THIRD WORLD

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Introduction

The topic assigned to me contains three aspects of the Farming Systems Research (FSR) methodology that has evolved through experience in recent years. "Small Farms in the Third World" is the common target population of many FSR projects, although the FSR approach is neither restricted to small farms nor to developing countries. Characterizing the farms in the selected area is the descriptive stage in the FSR methodology, and problem identification for the farms in the target population is the diagnostic stage. This paper will concentrate primarily on the issues and methodologies for description and diagnosis in the context of a FSR methodology.

Description of Small Farms

Choosing the proper attributes to describe the farms in a target population is the old boundary problem in systems definition. If "small farms" represents the group of primary concern, which farms will be defined as part of that group and which farms will be left out? Once the primary group has been isolated, what is the descriptive content that is necessary for adequate problem definition? Or, is it impossible to define the primary group without first knowing the problems? Whether these questions are "old hat" and already satisfactorily handled is a matter of perspective.

Some FSR practitioners say that the days of conceptualization are behind us, that all of the key variables for system description and problem definition have been isolated and that all we need to do is muster the necessary resources, conduct training, and get on with the job. Yet, there are others who believe that the evidence is not all in, and that the case is open for further debate which may lead to fruitful modification of FSR methodology. They claim that conceptualization must continue to keep before us salient features of the small farm production system that have heretofore been ignored or under-emphasized in FSR field operations. Spokesmen for this position do not claim that FSR should be all things to all people; they agree that to describe the complex view of the world held by many different farmers would contain more descriptive material than FSR project design and implementation could possibly worry about. They merely claim that as long as systems description is in the hands of agricultural/economists and agronomists, with very modest input from other disciplines, we are limited in our ability to describe the world as the farmer sees it and to identify the most important constraints experienced by farmers, which is the premise on which all FSR is based. Going further, they would argue that if we fail to treat as system determinants some of those environmental parameters that economists and agronomists take as exogenous and outside the control of <u>individual</u> farmers, then the FSR approach is subject to the same myopic vision that is characteristic of its predecessor, "commodity oriented" research.

With these divergent views, I face a dilemma in developing a topic. Any reference to old models and any further conceptualization will be regarded as mundane and unnecessary to members of the first camp. Nevertheless, I find no reasonable alternative to that of plowing some old ground. However the subject may be to some people, I find it necessary to retrace some previously traveled routes in order to find direction to where we may be going. This entails revisiting the "small farm" concept and some of the models that have been propounded to improve the understanding of small farm households. "Small farms" as a concept has been fraught with difficulty for as long as there has been interest in farm classification. Yet, it is to this poorly defined group that most FSR undertakings have been directed. We seek appropriate descriptive labels for this target population in order to justify development interventions intended to improve their conditions.

A typical characterization of small farms is to enumerate a list of negative attributes—problematic in nature—using relative terms with no more operational content than the initial relative term having to do with farm size (Harwood, 1979). Examples of such terms are "disadvantaged," "underdeveloped," "by-passed," "limited in resources," "low income," etc. If one reason for farm classification is to facilitate clear problem definition, it seems inappropriate to make the delineation among farms on the basis of problems that certain farms are thought to possess already. So, we continue to search for conceptual and operational models that not only differentiate sub-populations within countries, but also differentiate among countries according to levels of development. This interest has been revived with the coming of FSR programs where clear definition of the target population and specification of homogeneous farm types (common to a given recommendation domain) is part of the FSR methodology.

Before the advent of FSR, one of the most attractive approaches for classifying farms was to view farms as subject to stages of transitional development from subsistence farms to fully commercialized farms. Nakajima (1969) proposed that all farms of the world may be classified by using only two criteria: (1) the proportion of all production that is consumed by the producer and members of his household, and (2) the proportion of all labor in farm production that is provided by the household (Figure 1). The first criterion designates the extent to which the farm should be regarded as subsistence (or commercial) and the second criterion designates the extent to which the farm should be regarded as a family (or non-family) farm. In the pure cases, a farm-utilizing no hired labor and selling no produce would be a "subsistence family farm," and one utilizing only hired labor and consuming none of the production would be a "commercial non-family farm." Pure cases may be rare. Of particular interest are those farms found in the lower left quadrant of Figure 1, where both consumed production and family supplied labor constitute high proportions. It is possible that when it is written (Valdez, Scobie, and Dillon, 1979) that small farmers constitute the majority of agricultural producers in the developing world, reference is being made to family subsistence farms rather than small landholders. The family subsistence type may be found in parts of Africa on relatively large landholdings, and in parts of Asia on relatively small landholdings. From the standpoint of FSR, the land area differential for family subsistence farms need not present a serious difficulty because (within a particular recommendation domain) it is possible to isolate dominant characteristics with or without regard for farm size in terms of land area,

By concentrating attention on the subsistence and family labor aspects of a farm, it is possible to enumerate a number of characteristics frequently

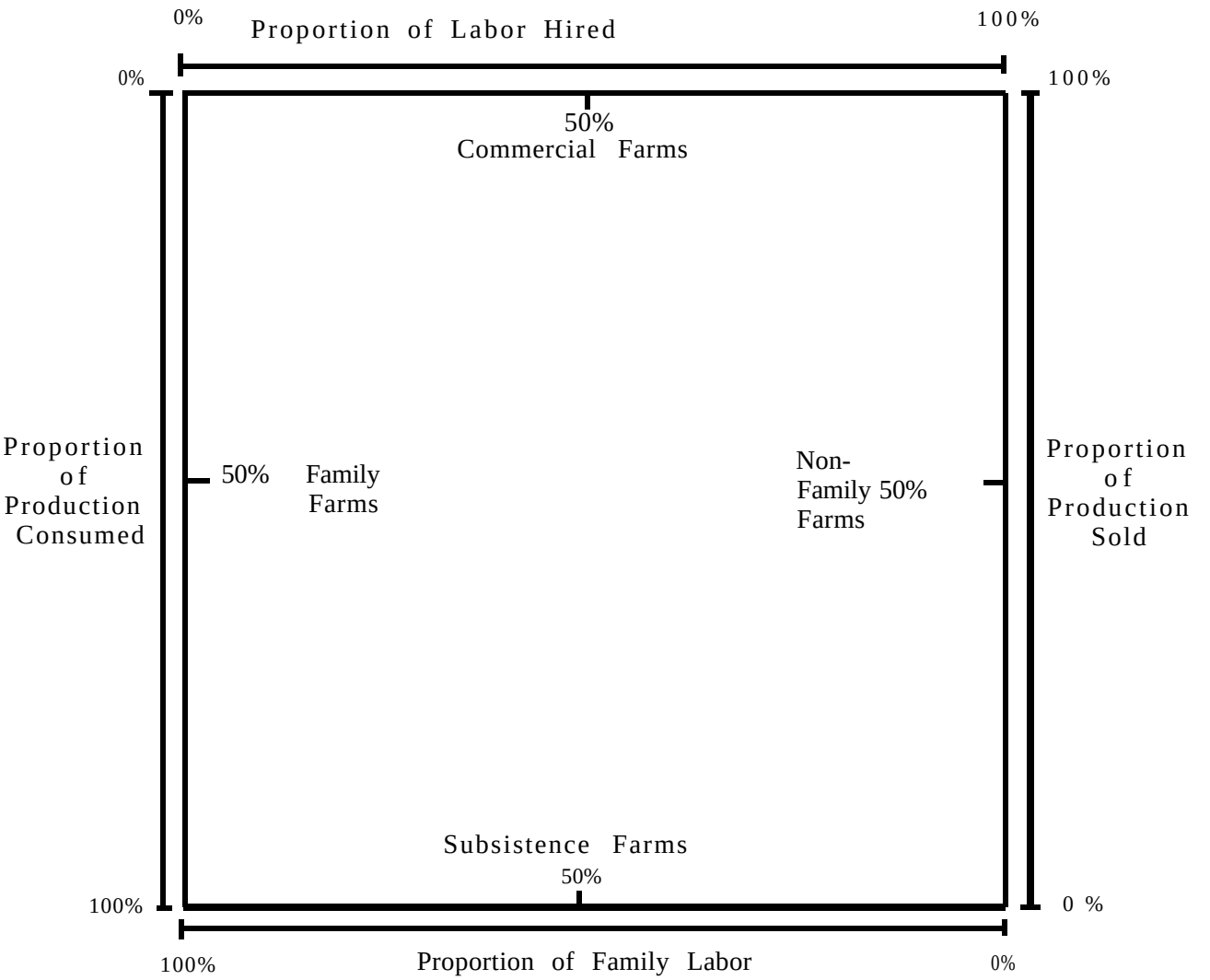

Figure 1.

associated with small farms in developing countries:

1. Cropping systems may be diversified and complex in order to meet a range of family food requirements.
2. Labor is the primary input in physical terms, and, to the extent that labor is hired in critical periods, this expenditure will dominate the pattern of cash production costs.
3. Cash needed for production expenses will compete seriously with family consumption needs. This places the repayment of farm production loans in jeopardy even when repayment is tied specifically to the harvest of the crop being financed.
4. By-product utilization from both crops and livestock receive special attention. Crops may be selected for by-product characteristics in lieu of, or in addition to, the attribute of maximum yield. Livestock enterprise selection may be tied closely to by-product availability, as well as to its contribution to critical cash consumption requirements or community obligations faced by the family.

5. Capital rationing strategies, combined with peak labor requirements in certain seasons, may call for exchange labor and community support systems rather than the substitution of machinery for labor.

6. Security and dependability of food supplies may take precedence over profit-maximizing decision rules.

I find it interesting that when these characteristics are enumerated today, they conjure visions of a two to five hectare farm somewhere in the developing world. I am old enough to have experienced a childhood on a Michigan farm with precisely these same characteristics; however, our family farm was, and still is, one of about 200 acres. It was an average-sized farm in those days. It is a small farm today. It changed from a subsistence family farm to a commercial family farm—not by increasing land area, but by changing the farming system and the level of technology.

The relationship between the subsistence versus commercial farm paradigm and farm productivity was developed by Owen (1974). The conclusion he reached comes as no surprise, namely, that an optimum may be found on farms with limited land area as well as on large farms. Eicher (1969), approaching the matter from another angle, has pointed out the fallacy of equating rural poverty conditions with surplus population countries. This is to remind us that in many areas of Africa and Latin America there is still a surplus of land in relation to the available agricultural labor—nevertheless, poverty exists.

However, this symposium was not called to discuss whether "small is beautiful" or "small is ugly." We may try to characterize small farms in the developing world and to define their problems or virtues, but, from a FSR perspective, size is of no particular concern. We can surmise that farms with similar cropping/farming systems, located in a particular agroecological zone, and subject to similar institutional constraints will be similar in size.

So, we move on to the systems boundary problem. Hyami (1978) would have us pay more attention to the peasant economy as a village phenomenon rather than overemphasize policy formation based on simply representative farm household research. In doing so, more attention would be given to such issues as the following: (a) the contribution to village income from non-village sources, (b) the potential for increasing income from nonland based sources such as ducks and hog raising, (c) the portion of village earned income that flows to absentee landlords, (d) income inequalities within villages and among villages, with special references to landless workers in agricultural production, (e) the consumption of goods and services for which there is high dependence from outside village sources, and the potential for minimizing this dependency, and (f) the opportunities for increasing community capital, with special reference to organizing village labor for effective capital formation during the periods of the year when the opportunity cost of labor is very low.

The kinds of issues identified by Hayami draw attention to many constraints to increasing household income that may be ignored—or merely recognized and passed over—by commodity-oriented research, whether it involves on-farm research or not. Certainly, some of these issues have been documented in the site selection and the descriptive work in some FSR projects; they are not completely ignored. But, implementing agencies for FSR projects have their own goals and objectives to achieve; the data collected and analyzed by these agencies will not surpass that needed to achieve those objectives.

Consequently, the system definition that appears adequate, and perhaps even overly extended, by one agency may appear unduly restricted by another. For example, non-farm employment may be of interest to ministries of agriculture, but, for both political and budgetary reasons, not receive attention in a FSR project. Nevertheless, in some communities, the kinds and level of constraints to farm production are intricately related to resource allocations between farm and non-farm activities.

Likewise, research institutes, whether they are national or international, may find their mandates far more limiting than the realm of management problems faced by farmers in the physical domain of their research. We need not be critical of research institutes for defining farming systems more narrowly than the farmer sees his own system. Indeed, we are indebted to the institutes for many contributions, including the following: (1) improved farming systems resulting from effective components research and efforts to reduce the yield gap between experimental and cultivator experience, (2) demonstration of the value of multidisciplinary research in the solution of farm production problems, (3) reorientation of research from single-location research stations to multi-location testing sites in farmers' fields, and (4) refinement of reasonably cost effective methods for collecting and analyzing FSR information. Despite these achievements, the question as to whether narrowly-defined, easily-managed research sub-systems (designed to give quick remedies that are largely restricted to field practices) are the best that we can expect from FSR remains unanswered.

To further illustrate the relationship between the institutional base and the way the target population (small farms) may be characterized, consider the universities in developing countries currently engaged in FSR; this experience is poorly documented in the literature so I must draw on my two-year experience with the Tech Pack Project implemented by Central Luzon State University in the Philippines. In this university setting—with a heavy commitment to rural development—there was a wide range of talent, in many scientific disciplines, to be recruited and trained for farm/village-level research. Farm households, and the farming systems that support them, were described with more variables than is the case for the more highly publicized FSR projects. We were frequently reminded by Dr. Firmena Rivera, the rural sociologist on the team, that the most important systems in FSR are human systems-not cropping systems or livestock systems, or power systems, or any other non-human system. Now that the Tech Pack Project is institutionalized, both philosophically and operationally, in the life and work of the university, there is no longer a tension about having to produce quickie results in order to establish credibility. If the farmers say that marketing is the bottleneck to farm profit rather than production technology, then that becomes the concern to the project personnel for research and action—even if marketing is a difficult nut to crack, and even if it may take a long time to produce positive results. The point that I am trying to establish here is that the descriptive data base used to characterize a farm population of interest depends on many things, including the purpose of the description, the breadth of expertise involved in the exercise, the research or action agency/institution using the description, and the goals of that agency/institution.

The difficulties in describing peasant agriculture were discussed by Wharton (1969) more than a decade ago. These are his observations:

> "The cultivation of agriculture throughout the world varies not only as to the crops grown and basic ecologic settings, but also as to the individuals who direct the process. When one

focuses upon the farmer as the central decision-maker, the agent which intervenes in, the original rhythm of nature, one finds an extremely heterogeneous group... Several distinctive labels are employed by each discipline to characterize different types, of agricultural cultivators. As would be expected, there are differences in the specification of these labels between disciplines and within disciplines. The critical difficulties lie in determining the variables or criteria which may be used to delineate each type and, for those criteria which involve discrete variation, in specifying the degree or cut off point which will separate the types."

As proposed by Wharton, the economic criteria will include variables such as the sale of farm production ratio; the ratio of hired labor or purchased inputs; the level of technology; and the opportunities for individual choice on the part of the agricultural cultivator.

The sociocultural criteria may include kinship roles and, responsibilities, plus cultural, social, and institutional forces that direct decisions and actions; exposure to change agents; and strength of community interpersonal relations and psychological differences that explain individual and family motivations and goal sets.

Viewed even from this limited disciplinary perspective, which largely underemphasizes geography, anthropology, and political science, plus a range of agricultural sciences, the task of characterizing subsistence agriculture becomes very complex. Individual disciplines do not claim to include all features of reality in their conceptualizations and empirical work; each selects only those variables that are most important for simplifying the complex reality to a manageable analytical model for its disciplinary orientation. The earth scientists will emphasize cultural management end productivity variables... the economists will stress profitability measures ...the cultural anthropologist will stress human behavioral traits. Each will defend his/her model vehemently and may charge that the other models are too narrowly conceived, too broadly conceived, or too static in form to be very useful.

Small Farm Problems and Problem Identification

In the conduct of FSR, problem identification has come to mean the discovery of constraints that impede progress on individual farms or on a number of farms in an homogeneous group. The solution of problems thus defined are solved by providing means or policies to relieve those constraints.

Hodgdon (1974) proposed that the constraints can be analyzed at three levels—namely, the individual farmer (situation variables), the village (local variables), and the world outside the village (external variables).

Situational variables may be analyzed under three major categories. The first is the farm unit, which considers size of farm, fragmentation of holdings, ownership status, and land fertility. The second includes the production resources of capital, irrigation facilities, equipment, family labor supply, and draft animals. The third treats the personal characteristics such as age, literacy level, subsistence orientation, and value of products marketed and business orientation, including the keeping of farm records.

Local variables refer to the following: (a) physical and geographical factors, such as topography and soil type, (b) village location in relation to

urban areas, for its bearing on communications, transportation, accessibility, input and marketing costs, as well as its effect on labor supplies and off-farm employment opportunities, and (c) social patterns and patterns of interpersonal relations, with special concern for the quality of village leadership.

External variables refer to information and input availability, as well as national price policy and availability of social services.

Hodgdon used this structure of variables for research in India. His findings may be representative of much of the developing world:

1. Institutional credit was very limited to those farmers in the lower range of farm size holdings.
2. Little attention is paid to those farmers who are ineligible for credit.
3. Small farmers hold the belief that new, recommended practices are intended for the big farmers.
4. Farmers have little control over critical input delivery systems. For example, the irrigation authority decides when and if farmers receive irrigation water.
5. Government policies and practices are not addressed to solving farmers' problems, and they are especially stacked against the interests of the smallest farmers.
6. Niggardly use of inputs results in low crop yields. Double-cropping may be followed merely to make up for shortfalls in the first crop—despite a low yield expectation for the second crop.
7. Farmer cooperative leadership is more concerned with meeting government targets than with serving local needs.
8. Input supplies are compulsorily linked with government credit and loan repayment is compulsorily linked with government buying practices which are unfavorable to the farmer.
9. Rigid loan recovery policies leave farmers bitter, frustrated, and despondent after years of bad crops.
10. The information system for farmers is inadequate in amount and in kind; frequently that which is available is incomprehensible or inappropriate.

These conditions are quite typical of those faced by small farmers in many developing countries. Some—but not all—of these conditions are being addressed by current FSR projects. Solutions for many of them require institutional reforms, which are considered outside the scope of the usual FSR undertaking. These so-called environmental constraints have high priority in the concerns of farmers, but, because of their political nature, they are difficult to address by agricultural research institutions. Many are researchable, and the results of such could yield high payoffs to small farmers; but such research probably would not qualify for FSR because the experimentation is difficult to conduct on farms. Therefore, FSR has focused on a different set of constraints.

Most on-field research has been directed toward yield constraints (IRRI). Problems are defined in terms of those variables which best explain why farmers' yields fall below potential yields. These variables may be identified

and evaluated, employing both informal and formal data gathering procedures and utilizing the expertise of a range of biological scientists, with some input from economists. Analysis of these variables will define farmers' problems with such terms as "unsuitable variety," "non-optimum nutrient levels," "weed control problems," "plant disease problems," "untimely cultural practices," "critical labor stress periods," etc. These types of problems are amenable to careful experimental design; conduct in farmers fields; and potential for solution in a relatively short time.

The conduct of such research also impacts on some of the other types of constraints mentioned above. From recent interviews with farmers and researchers in Pakistan, I learned that some of the issues mentioned earlier were being addressed, at least indirectly. Farmers who have been participants in yield constraints analysis programs gave researchers credit for making an attempt to deal directly with their problems at long last. However, participants were typically the more progressive farmers, and the so-called backward farmers had reason to complain that no particular attention was being paid to them. Technical information for farmers in general was improved, however, by the release through radio of actual farmer experience, and by farmers' ability to observe the results of field trials firsthand. Historically, the extension program has been very ineffective, and the programs that were undertaken (by researchers) to conduct adaptive research were actually regarded by farmers as extension field demonstrations. The extension service was largely by-passed in the conduct of on-farm research; one would not be far off In regarding the constraints analysis work as being as much Farming Systems Extension as it was Farming Systems Research. The results of the constraints analysis work to date have been so encouraging that during the coming year the government of Pakistan will launch a production campaign for wheat and rice that has a goal of increasing aggregate production by 50% in one production season. To accomplish this, at least some of the institutional constraints mentioned above will need to be confronted and relaxed.

Another indirect benefit of the adaptive research and constraints analysis work in Pakistan is related to researchers' attitudes. In earlier times, village work would have been considered "low brow" and lacking in professional prestige value; but having had some experience in "brushing" with farmers, researchers now seem to express satisfaction in being able to confront and solve problems directly and to accept on-farm research as respectable, and perhaps the "in" thing to do.

It is encouraging to note that even though the problems of small farmers in developing countries range widely, depending on location-specific circumstances, methods are evolving to identify them more clearly, and the research establishment is being oriented to cope with them more effectively than was true in the past.

Programs for Small Farmers

The shortcomings of rural development programs in developing countries are well-documented (Holdcroft, 1978), and any serious attempt to annotate them would go far beyond the space limitations of this paper. Retrospective analysis of those experiences, however, would highlight causal factors, such as (a) insufficient local participation, (b) the attempt to transfer inappropriate institutional arrangements and inappropriate technologies from developing nations, and (c) inadequate data and research for policy formation.

For present purposes, we are most concerned with the shortcomings of

conventional research approaches and their effect on rural development, especially as they relate to small farms. Whyte (1981) contends that research establishments in many developing countries are transplant systems from industrialized nations. What he calls the European colonial model (introduced before World War II in African and Asian colonies) was based primarily on large-scale plantations devoted to the production of export crops, especially those crops exported to the mother country. This research model has had little to offer small-scale farming and farming systems dominated by food and locally consumed commodities. Research was "top-down" in the sense that experiments took place at the research institutes and the results were relayed directly to the plantations for adoption. Small farmers could achieve little benefit from this approach.

After 1945, the United States undertook technical assistance and financial assistance programs in many parts of the world. The Point IV program carried with it the "land grant philosophy" of American universities which would link extension outreach with university-based research. For lack of university-based research, the emphasis was placed on the extension component. The importance of viable local research was underemphasized. The performance of extension workers was unimpressive for a variety of reasons—not the least of which being that they didn't have much to extend. What they had was likely to be poorly extended because the extension worker was less technically qualified than the farmer himself. Failures in the extension service were also coupled with lack of integration among various government agencies, difficulties in the credit system (especially policies that worked adversely against small farmers), serious marketing constraints (again with small farmers in a disadvantageous position), storage problems, and, finally, oversights with regard to the importance of women in the rural economy.

Shortcomings in both the European colonial model and the United States technical assistance models have emphasized the need to strengthen national agricultural research systems. Gilbert, Norman, and Winch (1980) have charged that public investment in agricultural research has been consistently skewed away from the needs of small farmers because it has been based on (a) the expressed needs of more influential farmers who often hold non-agricultural jobs in the society, (b) research that will appeal to professional "peer groups" of the researchers, and (c) types of technology that have been developed in high-income countries.

Farming systems research, or on-farm research, has been advocated and put into practice as a response to the above shortcomings. It has the merit of starting with the farmer, in terms of felt need, and ending with the farmer, in terms of specific improved practices. The methodologies for FSR are undergoing continuous refinement. National governments, international lending institutions, and donor agencies are placing great hope in the approach. Whether too much hope has been raised remains to be seen. The cost effectiveness of the approach has not been worked out very carefully to date, and will not be an easy assignment to accomplish. Payoffs to agricultural research in developed countries have helped provide the rationale for FSR in developing countries. In time, clearer readings on the full benefits of FSR in relation to its cost will become available.

In conclusion, I would like to share with you a poem about FSR that you may enjoy—I obtained it in the Philippines. To my knowledge, the author is anonymous. If any of you know the author, please let me know.

WHY DO THEY DO WHAT THEY DO?

Economists, agronomists, and planners of late
Have discovered a new way to pontificate
Beyond mere jargon, like "success enhancement,"
"Integrated development," "rural advancement"
Working in all their infinite wisdom
They're trying to define a "farming system"
To answer the question for all of you
"Why do farmers do what they do?"

At universities and experiment stations 'round the globe
In offices, labs, and on farms they probe,
Through consultancy surveys in developing nations
Upstream and downstream experimentations
With yield rates, inputs and multiple regressions,
Attempting to explain that profoundest of questions
With the diverse hypotheses they each eschew
On why farmers do what they do.

Variability and generalization,
Indigenous knowledge and maximization,
The issues discussed, the factors controlled,
Computers click, theories unfold.
Papers get published, conferences convened
Projects are funded; it becomes obscene
When predictably they conclude in the Final Review
That a more generous grant might give them a clue
As to why farmers do what they do.

Somewhere farmers plow and plant,
Milk their cows, work and chant.
After the interviews, trials and calculations,
The experts retire to their research stations
And the farmers continue to grow their corn,
While old women die and children are born,
They swap stories and drink their brew,
And they scratch their heads and wonder anew,
"Why do scientists do what they do?"

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SMALL FARM CHARACTERISTICS, PROBLEMS, AND PROGRAMS IN THE U.S.

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The decade of the 1970s witnessed an increased concern for the problems of small farms in the United States, as well as in the developing countries. This concern was evident among policymakers, academicians, and members of various organizations interested in social and economic change. Whereas agriculture had once been viewed as fairly homogeneous, it had become evident that considerable diversity exists and that many of the differences were related to farm size. Attention was called to the fact that policies and programs were not of equal benefit to the small and large farm.

What is a Small Farm?

Much attention has been focused on the definition of a small farm. A farm may be defined as small based on acreage, level of farm sales, or level of total income. Other restrictions may be placed on the definition, such as the importance of farm sales to the family income or the proportion of labor and management provided by the farm family. Almost regardless of the definition, considerable heterogeneity will continue to exist among those classified as small farms.

The U.S. Department of Agriculture (USDA) study of structure issues of American agriculture gave some attention to the small farm component of U.S. farm structure. Included in this study was a comparison of the distribution of small farms and the characteristics of small farms as they were related to the definition used (Carlin, 1979). One definition was based simply on total farm sales and, specifically, those farms selling less than $20,000 in farm products. The other definition was somewhat more complicated and included those families who (a) operate farms by providing most of the labor and management; (b) have total family incomes from farm and non-farm sources below the median non-metropolitan family income in their states; and (c) depend on farming for a significant portion, although not necessarily most, of their incomes. The first definition, would have included approximately 1.7 million farm operators in 1977, while the latter definition would have included approximately 1.3 million farm operators. Tables 1 and 2 summarize some of the information contained in the comparison of definitions.

Regardless of the definition, small farmers have some common characteristics; they are also concentrated in the south and the north central region. The major difference relates to the importance of off-farm income. Where the major criterion is level of farm sales, some farms will be included which have a relatively high level of off-farm income. On the other hand, if the limiting criterion is total family income, it may include some farms with somewhat larger gross sales, but low total family income (Figure 1).

Characteristics of Small Farms

By definition, the size of business on small farms is relatively small. The farms are small in terms of net farm income, quantity of resources, farm output, and total farm sales. While small farms may differ with respect

Table 1. Geographic Distribution of Small-Farm Families Under Two Definitions

Area	Farm Families with Incomes Below Median Nonmetro Income, 1975 (Definition A)	Farms with Farm Business Selling Less than $20,000 in Farm Products 1974 (Definition B)
	—Percent—	
Northeast	6	5
North Central	42	37
South	43	49
West	9	9

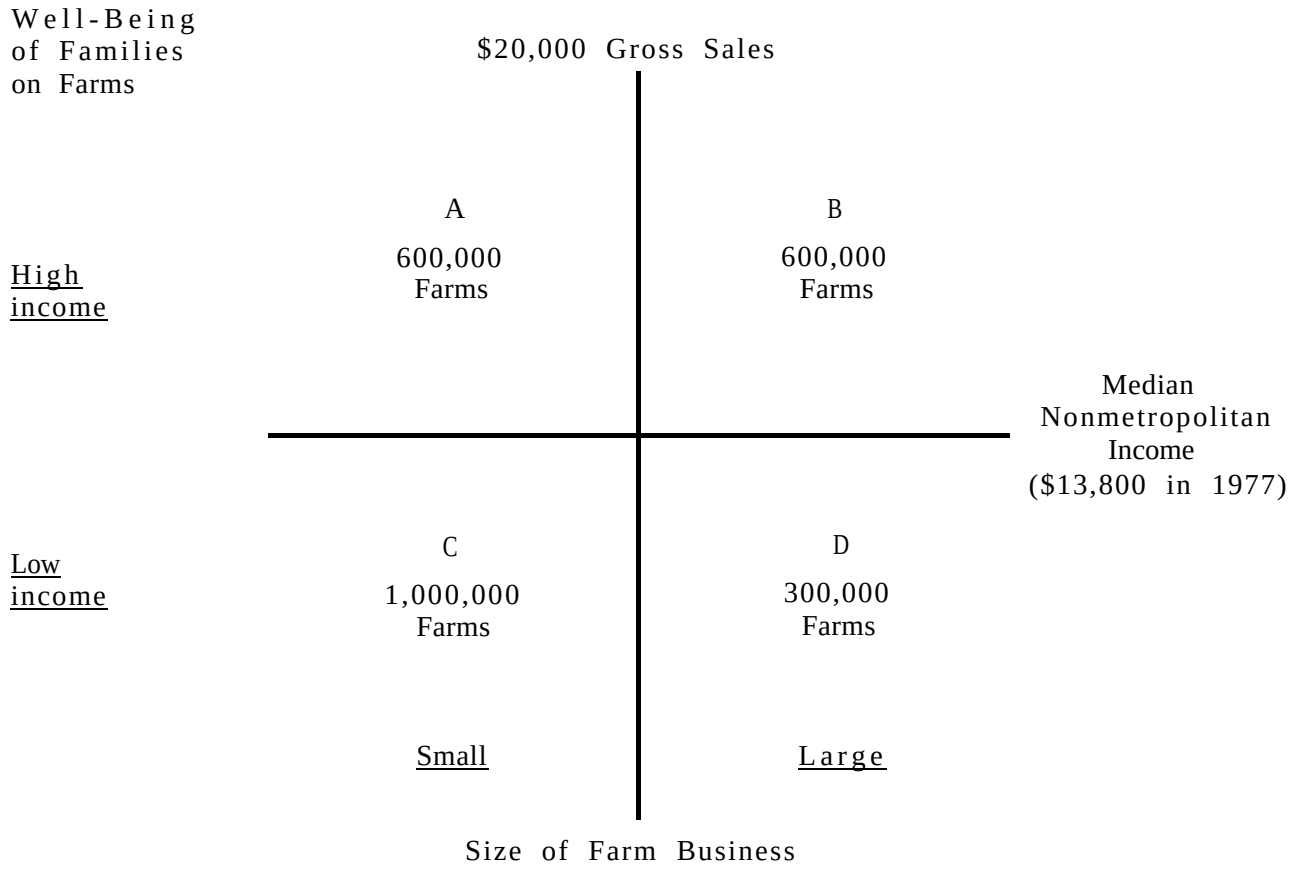
Source: Carlin (1979)

Table 2. Characteristics of Small Farm Families Under Two Definitions

Characteristic	Unit	Farm Families with Incomes Below Median Nonmetro Income, 1975 (Definition A)	Farms with Farm Business Selling Leas than $20,000 in Farm Products 1974 (Definition B)
Farming principal occupation	Pct.	69	48
Working off-farm 100+ days	Pct.	36	55
Average total family income	Dol.	5,600	10,400
Average net farm income	Dol.	1,500	1,100
Average off-farm income	Dol.	4,100	9,300
Average age	Yrs.	53	53
Average value of farm sales	Dol.	10,800	4,400
Median size farm	AC.	135	82
Median market value of farm assets	Thous. Dol.	142	91
Median net worth	Thous. Dol.	110	84

Source: Carlin (1979)

Figure 1. Classification of Farms



to these measures (depending upon the definition), they are generally the basis on which small farms are singled out for special attention or treatment.

Size of Business

Small farms are obviously those on the small end of the continuum with respect to farm sales. The cut-off point has varied over time as would be expected with changes in the price level. For example, in the early 1970s, a $10,000 gross sales figure was sometimes used as the dividing point. Today, many argue that this level should be nearer $40,000. As shown in Table 3, the proportion of farms that would be included would vary depending upon the maximum level of gross sales. If only those farms with less than $20,000 gross sales were included, approximately two-thirds of U.S. farms would be classified as small. Raising the limit to $40,000 would include another 12 to 13 percent and would, thereby, include approximately three-fourths of U.S. farms. While the level of farm sales is not perfectly correlated with the farm family's total income, there is a high degree of association. The extent to which this is true, of course, depends upon the importance of off-farm employment to the individual family. Certainly, for those families dependent upon the farm for their livelihood, a low level of farm sales implies a low family income.

While the size of the farm business is important with respect to the level of economic well-being, it also has implications with respect to efficiency. Even for those small farms that are highly specialized, which most of them are not, the scale of enterprise is relatively small. The extent to which this is a problem will be discussed In more detail in the section on problems of small farms.

Limited Resources

Resources are limited on small farms. This is true for land, capital, management, and even labor in many instances. The limitations Imposed by land and capital are evidenced in Tables 4 and 5. While the labor and management limitations are not so obvious, the fact that small farm families must often divide their time between farming and off-farm work may result in neglect of the agricultural enterprises.

While approximately 64% of U.S. farms were classified as small farms by the under $20,000 gross sales definition, these farms controlled only 21.7% of the land in farms. The situation with respect to harvested cropland is even more severe, since small farms controlled only 15.9% of the harvested cropland. This is very evident in states like Missouri, where many of the small farms are on land which is rough and not very productive. As a result, the land resource constrains both the type and scale of enterprise on small farms.

It is true that small farms own a much larger portion of the land that they farm. In 1978, small farms owned 82.4% of the land on their farms while farms grossing over $100,000 owned only 56.2% of the land. This tendency to rent less land relative to that owned may be due either to hesitance to rent or inability to rent because of other limiting resources.

Capital is also limited on most small farms. As indicated in Table 5, small farms contained only 25.5% of the total value of land, buildings, machinery, and equipment on U.S. farms. They are also relatively small users of credit, as indicated by a debt to asset ratio in 1978 of only 6.3 compared

Table 3. Distribution of Farms in the United States by Level of Farm Sales, 1978

Sales Class	Number of Farms	Percent of farms
Less than $20,000	1,584,163	63.9
$20,000-39,999	306,112	12.4
$40,000-99,999	363,383	14.7
$100,000 and over	222,682	9.0
Total	2,478,642	100.0

Source: 1978 Census of Agriculture (1981)

Table 4. Distribution of Land Among Farms in Various Site Classes, U.S., 1978

Sales Class	Land in Farms	Percent of Land	Average Size
	(Acres)	(%)	(Acres)
Less than $20,000	223,834,706	21.7	141.3
$20,000-39,999	133,076,070	12.9	424.7
$40,000-99,999	245,240,465	23.8	674.9
$100,000 and over	371,266,104	36.1	1667.2
Total	1,029,694,535	100.0	415.4

Source: 1978 Census of Agriculture (1981)

to 23.5 on farms grossing over $100,000, Very little is known of the extent to which the failure to use more borrowed capital is related to internal or external capital rationing. Again, the shortage of capital imposes constraints on both the type and scale of enterprise. In interviews of approximately 8,000 small farmers in Missouri during 1977, approximately one-third indicated financial problems as the most serious problem faced by their family, and approximately 20% gave lack of operating capital as a problem or reason for failure to expand the farming operation.

As indicated earlier, the human resource may also be limited on small farms—this is true both in terms of quantity and quality of the human resource. While emphasis is typically placed on the physical resource limitations, it may well be that the limitations imposed by the human resource imposes an equal or even more serious constraint upon the small farm operation. Studies have shown that small farm operators tend to have a lower level of formal education, have a greater incidence of disability, and often do not have a skill marketable in the non-farm economy. Those not possessing these characteristics are more likely to be involved in off-farm employment, and hence be dividing their labor and management between the farm and off-farm job. This again may influence the type of enterprise selected, the size of the enterprise, and the timeliness with which agricultural operations are carried out. Studies in Missouri of small farm operations indicate the importance of this latter factor, particularly as it relates to the productivity of small farms.

Off-Farm Employment

Operators of small farms are very likely to be involved in off-farm jobs. As shown in Table 6, over half of the small farm operators were employed more than 200 days off the farm; in many families, both husband and wife are employed at least part-time off of the farm. This is particularly true of younger families (West, 1978).

Age Distribution

The age of small farm operators is slightly higher than those with larger farm businesses, In 1978, 20.5% of the small farm operators were over 65 (Table 7); the average age of small farm operators (less than $20,000) was 51.1 years while the average age of those grossing over $20,000 was 48.2 years. This certainly does not imply that all small farmers are older—but for those who are, there are some important implications in terms of the objectives of the operator as well as the operator's alternative off-farm employment opportunities.

Small Farm Objectives

The objectives of small farm families differ considerably from those of commercial farm operators. While a considerable portion of the small farm families would like to expand their farm operations, others are content with holding the farming operation at a given level. Likewise, while some farm families would like to maximize the level of farm income from the resources they control, others are more interested in minimizing the cost of living in a rural setting. Still others, particularly those in the older age brackets, are concerned with integrating the farming operation into their retirement plans and perhaps transferring the farm to the next generation.

Table 5. Value of Land, Buildings, Machinery and Equipment on Farms of Various Size Classes, U.S., 1978

Sales Class	Value	Percent of Total	Debt to Asset Ratio
	(000$)	(%)	(%)
Less than $20,000	186,131,983	25.5	6.3
$20,000-39,999	92,631,456	12.7	16.9
$40,000-99,999	183,244,040	25.1	19.2
$100,000 and over	258,929,811	35.5	23.5
Total	729,507,751	100.0	15.7

Source: 1978 Census of Agriculture (1981)

Table 6. Distribution of Farm Operators by Days Worked Off-Farm for Various Size Classes, U.S., 1978

Sales Class	Days Worked Off-Farm			
	None	1-99	100-199	200 and over
			Percent	
Less than $20,000	29.9	8.8	9.6	51.7
$20,000-39,999	53.0	15.7	8.7	22.6
$40,000-99,999	67.6	16.8	5.2	10.4
$100,000 and over	75.8	13.0	3.4	7.8
Total	42.3	11.2	8.3	38.2

Source: 1978 Census of Agriculture (1981)

The diversity of objectives is indicated somewhat by Figure 2, which illustrates the different types of farms that may exist, given the diversity in size of farm operation, extent of off-farm employment, and age of the operator.

The diversity of goals is also illustrated in the results from a survey of small farmers in five western states. In addition to the typical economic goals, those mentioned by families surveyed included raising children on a farm, growing things, independence, seclusion, or simply doing farm work as a hobby (Young, 1981).

Problems of Small Farms

Given the characteristics of small farms just described and the diversity in those characteristics, it is to be expected that their problems would also be numerous and quite diverse. The young, full-time farmer attempting to secure a place among the commercial farm population has problems quite different from the older farmer who depends primarily on off-farm income and is primarily supplementing his off-farm income with some income from the farm operation. While there are obviously great differences in the problems and the severity of those problems, there are some generalizations which can be drawn and some problems which tend to be fairly common among most small farmers.

Number and Complexity

The number and complexity of small farm operations is a problem in itself since it is difficult to develop public policies and programs to alleviate the variety of problems and also reach the large number involved with the programs developed. An example might be in terms of efforts to improve production practices on small farms. Given the large number of enterprises involved, the large number of farmers, the farmers' tendency not to attend meetings, and the ineffectiveness of mass media with this clientele, the diffusion of information is very difficult.

The complexity of small farm operations is also a problem in that there are multiple goals. Involvement in off-farm enterprises, as well as farm enterprises, increases the difficulty of developing appropriate strategies. Essentially, the problem becomes one of a multiple objective function, numerous enterprise alternatives, and severe resource constraints.

Limited Resources

As indicated earlier, one or more resources are limited on most small farms. This has serious implications for the small farmer's ability to achieve an optimum combination of resources, realize economies associated with size, and provide the family with an adequate income. Although a number of empirical studies suggest the small farm may have problems in these areas, the studies that were made are out of date—and, in some cases, did not address the question relevant in this instance. Most of the studies of economies of size were made in the 1950s and 1960s and were directed toward determination of the long-run average cost curve. They did not address specifically the extent to which the small farm might be viable—from an efficiency standpoint—or the approaches which might be used to enhance its viability (Johnston, 1980).

Most economies of size studies point to some economies associated with size, but suggest that unit cost may be approximately constant over a wide range of size. However, the paint at which the cost curve flattens out may be

Table 7. Age Distribution of Farm Operators in the United States by Level of Farm Sales, 1978

Sales Class	Under 25	25-44	45-64	65 and over
		Percent		
Less than $20,000	3.2	31.3	45.0	20.5
$20,000-39,999	4.4	31.1	51.2	13.3
$40,000-99,999	3.2	36.2	52.9	7.7
$100,000 and over	1.4	38.3	53.9	6.4
Total	3.2	32.6	47.8	16.4

Source: 1978 Census of Agriculture (1981)

Figure 2. Preliminary Structure of Categories for a Typology of Small Farmers

	Sales Volume (Gross Farm Income)							
	Low (less than $10,000)				Moderate ($10.000-39,999)			
	Young (49 years or less)		Old (50 years or older)		Young (49 years of less)		Old (50 years or older)	
	Full-time[a]	Part-time[b]	Full-time	Part-time	Full-time	Part-time	Full-time	Part-time
Category	Homesteader	Hobby farmer	Limited-resource/ poverty farmer	Retirement/ U-turn farmer	Full-time small farmer	Early-career/ supplemental-income farmer	Disengaging farmer	Persistent supplemental income farmer

a Full-time farmers are defined as those farm families who have no off-farm wage income.

b Part-time farmers are defined as those farm families who have off-farm wage income.

Source: Buttel (1981)

beyond that realizable on most small farms. For example, Carter and Dean (1961) suggested the cost curve might be relatively flat over the farm revenue sites of $120,000 to $400,000. Similarly, Madden (1967) indicated that all of the economies of size could be attained by modern and fully mechanized one-man or two-man farms, and Raup (1969) points out that most economies of scale studies do not consider the after-tax position of owners, which he considers crucial to an analysis of farm size.

Seckler and Young (1978) offer a somewhat different suggestion to explain agriculture's long-run average cost curve. They argue that the cause of increasing farm size may be more nearly one of different managerial abilities among farmers. They suggest that at each farm size there exists both efficient and inefficient managers. Their argument goes on to suggest that efficient managers will want to expand their operations, and probably can at the expense of the inefficient managers. Seckler and Young also suggest that variations in the cost/returns ratio between farms of the same size would be larger than variations in the cost/returns ratio between farms of different sizes. Hence, they suggest that farms become large because the managers are efficient and that society may not necessarily be worse off in terms of allocative efficiency if small farms predominate.

Clearly, new studies of economies of size are needed with today's higher investment requirements, higher input prices, and changes in tax policies. Even if small farms can compete from an efficiency standpoint, with the resource limitations they face, the farm may not provide enough income for the family to have an adequate level of living. In other words, small size farming units might have cost/revenue ratios less than unity, but still have inadequate net income to repay the operator and management at their opportunity cost levels; for example, a small farm might earn $50 net income per acre from producing a particular crop, but if the farm only has 160 acres the $8,000 might not be adequate for the family or might not be as much as could be earned off the farm.

Since land is often a limited resource, on small farms, more intensive type enterprises are often suggested. However, this typically requires greater inputs of capital, labor, and management. Furthermore, the enterprise may not be one familiar to the small farmer and markets may not be readily available.

Technology

Technology has been a major force of change in agriculture during recent decades, particularly during the 1950s and 1960s. However, small farms have often not been major beneficiaries of such change. The new technology was often more adapted to large land units and often required major inputs of capital. Small farmers tended to be left behind because of limited capital; small land units on which to apply the technology; aversion to the risk of adapting new technology; and, in some instances, lack of information about new technology.

The development of new technology and its consequences were not the result of any sinister plot against small farms. Researchers assumed that their research and the technology resulting from that research was size neutral; this assumption was seldom questioned. Agribusiness was producing products for which there was a market and that market was typically larger on the large farms. In recent years, there has been some concern with the development of "appropriate technology," but it remains to be seen if technology can be developed that will enhance the viability of small farms.

Markets

Volume has become a key to successful marketing of agricultural products. In the United States, the large retail food chains demand a large volume of highly standardized products—and a dependable supply is a necessary condition. Small farms obviously have difficulty meeting such demands. The result has been that many markets that were once accessible to small farms are no longer available. Small farms must either produce those products for which markets are readily available or develop alternative marketing outlets.

Development of market outlets for specialty crops is particularly difficult. Yet, it is fruits and vegetables that are often suggested as the appropriate enterprises when a small farm is encouraged to intensify. The world of the produce broker is a mystery even to the person knowledgable about the marketing of fruits and vegetables. Even if the market can be accessed, it demands a large volume of product, and, hence, marketing institutions must be developed that can assemble the products from a large number of small farms. The alternative sometimes suggested for fruits and vegetables is that of direct marketing to consumers. Success stories can be pointed out, but the potential of such markets and the keys to success have not been well-defined (Thompson, (1980).

Public Services and Programs

One would have difficulty finding a public service or program that clearly states it is not available for use by small farms, yet, small farmers quite often feel this to be the case. The realization of this fact led to the development of a special extension program for small farms in Missouri during the 1970s. Similar efforts made at the federal level by a number of USDA agencies were initiated under Secretary Bergland as a follow-up to the small farm conferences conducted in 1978.

The reason why small farmers fail to avail themselves of public services or participate in various programs are quite numerous. They include (a) the real or unwarranted feeling that a specific program or service is not for them; (b) actual experiences in which the content of programs or services were found not to be relevant to the small farm; (c) a feeling of inferiority which developed when forced to participate along with much larger farmers; (d) lack of information about the relevance of particular services or programs; and (e) the resource requirements necessary to make participation feasible.

It has only been within recent years that efforts have been made to examine the distribution impact of various public services and programs. One of the first attempts was made during the Rural Poverty Commission activities of the 1960s (Bonnen, 1968). Subsequent to that effort, there have been attempts to examine the extent to which programs involving credit, price support, marketing, tax policy, energy, environmental regulations, water rights, education, and research have impacted differently on farms of varying size. Many knowledge gaps still remain, as evidenced by a National Rural Center study of an agenda for small farms research (Madden and Baker, 1981).

Risk Aversion

Risk and uncertainty have always been problems in agriculture. Yields are subject to considerable variation because of weather. Input prices vary and, hence, can increase or decrease markedly. Output prices and even access to markets can be uncertain. All of these impact on the small farm and

influence the farmer's willingness to make changes in his farming operation.

The level of risk aversion tends to be higher on small farms. Neither the level of assets nor the record of past successful experiences are such as to build confidence and thereby reduce this risk aversion. This tendency to avoid risk is evident in small farmers' failure to make use of credit and hesitance in adopting substantial changes in the farm operation.

Small farmers' aversion to risk may be well-justified, given their low level of assets. A recent study at Iowa State University indicated that small farms are particularly vulnerable in times of cost-price squeeze in agriculture if they have a low level of equity in the farm (Drabenstott and Heady, 1980). Recent high interest rates have dramatized the cash flow consequences that can result when farmers over-extend themselves. Operators of small farms are simply not willing to incur the risk of mortgaging their farm in order to make changes in the farming operation. Since other forms of security for loans are often minimal, this imposes another limitation on the small farm.

Motivation

Small farmers are not as motivated to seek information or make changes in the farming operation as are larger farmers. Given the scale of operation, the rewards for making small changes are not as great, and large changes involve considerable uncertainty which conflicts with the farmer's aversion to risk. For those farms that are small and have been small for a number of years, the lack of motivation on the part of the farmer may well be an explanation for his failure to increase the size of unit. While lack of motivation is a problem within itself, it also has implications and becomes particularly serious in attempting to deal with the other problems faced by small farmers.

Programs for Small Farms

Ideas for programs to alleviate the situation on small farms flow logically out of the discussion of problems. The characteristics of small farmers also have implications for the kinds of programs that would be meaningful. For example, the young, full-time farmer wishing to expand does not need the same type of assistance as the part-time farmer who is about ready to retire. While an attempt will be made to suggest a number of general type programs that would be helpful to small farms, it must be kept in mind that the relative usefulness of any of these programs will vary considerably depending upon the specific type of small farm involved.

Management Assistance

The management problems on small farms may be of equal or greater difficulty than those on large farms. Granted, the absolute number of dollars involved in a given decision may not be as great, but a few dollars relative to the income and assets of the farm family may be quite important. Furthermore, the resource limitations impose serious restraints upon the managerial decisions. In those instances where the small farm attempts to intensify in order to increase its size of business, both the production and marketing problems pose difficulty for the manager.

Experience in Missouri, as well as a number of other states, has shown that educational programs can be successful in improving the level of living On small farms (West, Harrold, Schneeberger, and Williamson, 1975; Orden, Buccola, and Edwards, 1980). Small farm operators can be assisted in their choice of

enterprise, selection of production practices, marketing decisions, and the actual execution of production and marketing processes.

There is a role for both extension and research in improving the management capabilities of small farm operators. Once it is recognized that small farms are different from large farms, the implication follows that research may need to be designed specifically to meet the needs of small farms. Experience has also shown that extension programs that are successful in meeting the needs of the large farmer may not be reaching the small farmer. Although some of the programs might be more relevant to small farmers than anticipated, a special program may be needed initially to establish contact with the small farmer and involve him in educational activities.

Marketing

Availability of, and access to, markets cannot just be assumed—history indicates just the opposite. Programs that allow small farmers to maintain access to markets become particularly important for the traditional commodities. This may mean special institutions to assemble and group the products from several farms. In the case of specialty crops, programs may be necessary to develop alternative markets. Some of the direct marketing activities of the late 1970s were a step in this direction.

Credit

Some of the resource limitations can be relaxed with the implementation of credit programs specific to the needs of small farms. These programs have been in existence, in some form, for several decades. In some instances, these programs were designed to help farmers just beginning to gain control of resources while, in others, they were directed more toward the operating needs of small farms.

Access to credit is increased, and credit programs are generally more successful in improving the situation on small farms, when credit is combined with management assistance. One benefit flowing from the Missouri Small Farm Extension Program was the increased availability of credit for the participants (West, Harrold, Schneeberger, and Williamson, 1975). Supervision or management assistance has long been a part of the Farmers Home Administration (FmHA) program with small farms; however, reductions in budgets, particularly for personnel, have diminished their ability to provide such assistance and has led FmHA to emphasize larger loans.

While credit programs can be of assistance in eliminating, or at least reducing, the resource constraint, it is important that ability to repay the loan be present. This, however, is not always the case. The Iowa State University study on small family farms and their projected incomes indicates some real potential for cash flow problems on small farms during periods of cost-price squeeze (Drabbenstott and Heady, 1980). In this study, only those farms with considerable equity or those with a large amount of off-farm income forthcoming were able to meet their cash flow needs.

Government Commodity Programs

The commodity programs of recent decades have not been pointed specifically to small farms. In fact, as Paarlberg (1980) suggests, there has been lip service given to helping the small farmer, but most of the commodity programs have been directed toward the needs of commercial farms. It is true that

commodity programs could be restricted to assistance for small farms or scaled to provide them greater benefits, but such has not been the case. The only way in which programs have been slanted toward small farms is in terms of the minimum acreage allotments used for some commodities and the relatively liberal payment limitations of recent years.

The summary report of the USDA study of the structure of agriculture suggests that we have entered a new era with respect to commodity programs (USDA, 1981). A characteristic of this new era is the absence of a need for programs to enhance income of the larger, more successful farmers. The report suggests a continuing need for stabilization programs, but that such programs would not be of much benefit to the small farmer. Since the small farmer still does have income problems, they indicated that a more direct type of assistance might be needed, such as some type of modified target price-direct payment program with the amount of assistance geared directly to the production cost of this specific group. Although such a program might make sense in terms of need, such does not appear a likely prospect in the near future.

Tax Policies

Although tax policies are not programs as such, they do have an impact on the well-being of farmers. The ways in which taxes are levied can influence the distribution of income and wealth in agriculture. Most taxes have some impact on agriculture, but those involving income, property, and estates are of prime importance. Although all farmers benefit from some of the tax rules specific to agriculture, the overwhelming evidence shows that the large farmers are the major beneficiaries. For example, the recent USDA structure study states "research results to date are consistent on one point: the direction of change caused by tax policies has been toward increased concentration of farm production and wealth and perhaps, more capital intensive technology" (USDA, 1981). These impacts have come primarily through policies that encourage the substitution of capital for labor and those that encourage the investment of non-farm capital in agriculture in order to realize certain tax advantages.

It is ironic, but true, that small farmers are supporters of the very tax rules that tend to be to their detriment. To the extent that small farmers pay taxes, they do obviously benefit from the lower taxes as a result of the rules. However, in the process, the large farmer or the person outside of agriculture with higher off-farm income, which he needs to shelter, can benefit even more and hence enhance his competitive advantage,

Rural Development

Up to this point most of the programs discussed have related to agriculture; as such, there is an obvious need for programs to improve job opportunities and enhance the quality of life in rural areas. It is obvious that many small farms will continue to be dependent upon off-farm income for an adequate level of living, To focus on programs specifically for agriculture and ignore the off-farm sector would not be in the best interest of small farmers.

Most small farmers need off-farm income to supplement the earnings on the farm. Some small farms are such that the business will never provide adequate earnings for the family, while on others the cash flow requirements may temporarily be such as to require one or more members of the family to work off the farm. Ideally, industries or types of employment would be brought in which provide employment off-farm that would mesh well with the small farm household’s other objectives, including working part-time on the farm. If this

is impossible, the farm operation must be planned and operated in such a way as to be consistent with the off-farm employment.

While small farm families are interested in more jobs and better jobs, they are also very concerned about the quality of life in rural communities. Part of their reason for living on the small farm is often related to this concern. This emphasizes the need for the entire gamut of programs typically included under the heading of rural community development. In general, small farm families are interested in assistance in making the small farm more viable, improving job opportunities, and having a higher quality of life in the community.

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SESSION I PANEL REMARKS

Charles Bussing, Department of Geography, Kansas State University, Manhattan, KS:

Farming systems are complex. Because of the intricate interactions within the system, a small change at one point often sets off far-reaching and unforeseen consequences elsewhere in the system. Research has much to contribute to an understanding and improvement of farming systems, but, to be successful, the researcher must be unusually adept at seeing the world from multiple points of view, including, and most importantly, the view from the farmer's perspective.

This conference is intended, as the title suggests, to help agriculturalists and others gain insights into farming systems so that those systems can be improved. Increasing population is placing greater stress on the world's resources, and uncultivated lands are rapidly dwindling. Much of the food for future generations will have to come from increasing the productivity of already cultivated areas.

As noted in the papers, the factors that limit food production on small farms in both the developed and underdeveloped nations of the world are virtually unlimited in number and variety. The small farmer may lack access to land or may not have enough land to increase production; capital may not be available; family labor may be scarce. These are only a few of the many problems the farmer may have to deal with.

Agricultural development programs—faced with complex and numerous limitations, each an impressive problem in itself—have tended to concentrate their efforts on a limited range of factors that seem most crucial to crop and animal production and, therefore, most amenable to improvement. As a result, high-yielding grain varieties have been developed, fertilizers and other inputs have been widely introduced, and extensive development of water resources for irrigation has taken place. Consequently, national food production in less developed countries has, to a degree, been able to keep pace with rapidly rising demand; however, production increases have come primarily from the most favored agricultural areas where limits on production are relatively modest. The growing concern for the well-being of limited-resource farmers who have been little affected by new technologies (coupled with the increased demand for food production) has increasingly drawn attention to the problems of small farmers.

The key to farm productivity and family well-being, when resources are limited, lies in an understanding of varied, but complementary, farm enterprises. Traditionally, analyses of these interactions have focused on larger, more productive farm units and have emphasized labor productivity and return on investment as the crucial variables. Small farmers seldom have the option of varying their capital.

Historically, development programs have often concentrated on a single commodity. Understandably, these programs have been most successful in areas where farmers depend on a single food grain, and where there are profitable markets for their production. Small farmers, however, usually find such programs unacceptable or totally irrelevant because they do not encompass the variety and mix of livestock and crops that are their daily concern. Further, these programs often place them at the mercy of market forces over which they have no control and probably do not understand.

In general, agricultural researchers have tended to become more and more specialized, and agricultural production has been divided into smaller and smaller units. The traditional approach has two important weaknesses. First,

units are studied in isolation, and interaction between the unit and other systems is most often ignored. Second, agroecosystem components have received more attention than agroecosystems and farm, regional, and national systems.

Agricultural specialists, in too many cases, have studied the systems within a region as if they were isolated phenomena. Agronomists breed "better" varieties, soil scientists measure fertilizer responses, entomologists identify "better" pesticides, and agricultural economists develop "better" models to analyze single-product marketing systems. This research, generated in isolation, is expected to somehow produce agricultural development and enhance farmers' well-being.

The "green revolution" approach is a highly specialized form of traditional agricultural research, based on the assumption that the availability of higher-yielding crop varieties will produce regional development. Crop varieties are often developed and evaluated in isolation from the systems in which they function as components. For the green revolution approach to work, the farmer must integrate the new variety into his crop system, the modified crop system into his agroecosystem, and the modified agroecosystem into his farm system. It is assumed that the impact of such modified crop systems in a specific geographic region will result in regional development. This type of approach may work in a one-crop farm system; however, in complex agroecosystems with complex crop systems, with complex farm systems, in complex regions, (as is not uncommon in the Third World) the chances for success are minimal.

If an important objective of agricultural research is to provide information in support of national regional development, as is often the case in Third World countries, it is obvious that the Interrelationships among agricultural systems within a region must be defined and studied through an integrative approach. The reductionist assumption that complex regional agricultural processes can be improved by independently carrying out another commodity study, breeding better crops, or setting up more fertilizer experiments should be replaced by a systems approach in which the relationships among agricultural systems receive at least as much attention as the study of the isolated phenomena, The systems approach requires the integration of an interdisciplinary team of agricultural research specialists. The research strategy followed by the team should include studies of the total environment in which small farmers exist.

Farming systems research, as it is evolving, is a positive step in the right direction and offers us a methodology, if properly applied, to improve the quality of life for many of the world's disadvantaged small farm families. Small farm problems are simultaneously a global problem and a local and individual one. In an interdependent world plagued with resource scarcity and continuing population growth, the challenge for all of us is to be less parochial and to think in broader system terms if we are to meet the challenge of improving the welfare of small farmers wherever they may be found. The papers this morning provide us with a useful base to begin our deliberation and discussion.

Marvin Fausett, Southeast Area Extension Office, Kansas State University, Chanute, KS:

I've certainly enjoyed the conference. Dr. Johnson's description of the development of farm management was very intriguing to me because I think it fits in somewhat with my background... I've been involved only in domestic programs. I've not really been involved in International development, other than participating in the international highland symposium in West Virginia.

That symposium did point out that highlands are usually small farms—I think these two conferences tie together. We have experienced a lot of the frustrations in domestic programs that have been mentioned here—I think because administrators do not understand exactly what farm management and working with the farmer and family interrelations mean.

It was pointed out in previous discussion that we get a little too much into technology. We really haven't been concerned about the family and decision-making as much as we have with the adoption of new technology,

Dr. West did a very good job of pointing out the definition of a small farm—basically, we define a small farm by definition, though the definition needs to be a bit specific to the target audience.

In a program in West Virginia in which we worked with small farms, there was a farmer with 777 acres. He had 30 acres of pasture, 7 acres of meadow, and 20 cows; the rest, 740 acres, was waste and timberland. He was a small farmer, even though he had a large acreage.

I'd like to point out the importance of the goals of the small farm family. They, are not necessarily income maximization. There are many other goals; I think we need to recognize that as we pinpoint our program to a specific audience. There is a diverse audience within the small farmers here in the state; we have a wide array, from small farmers to hobby farmers to full-time subsistence farmers. We need to target our projects, our goals, and our plans to specific audiences. Dr. Vincent pointed out some of the things we need to consider in working with individual farmers within a community and within a nation. All of these things are coordinated together—we're not just working with a group of individual farmers in an isolated chamber. This, to me, is the real point of farming systems research.

I'm very encouraged by the definition and the activities that are going on in farming systems research from the standpoint of working with individual farmers. I've elected, in my career, to work with the individual and to actually help him adopt some of the new technology. I think the farming systems research approach is a very positive step in that direction and I am very encouraged. I have several points, though, that I think farming systems research needs to consider. One, I think the researchers need to be responsible for transferring the knowledge to the farmer. The program in West Virginia started out as a rapid technology transfer to farmers; it ended up, in a few years, being very similar to farming systems research. We did on-farm research; it was transferred back to the university; and the university modified it for this program for the development of small farms in the Northeast of the United States. I think it needs to be people-oriented. People produce food, and people with technology may produce more food, but technology without people is useless. Also, it needs to be oriented to the farmer, and yet it needs to be involved in the community or the village and be taken into consideration with the national policy...

<u>David Norman,</u> Department of Economics and Agricultural Economics, Kansas State University, Manhattan, KS:

Three substantial papers have been given in this session, with the keynote address, in particular, containing some provocative issues. There are many issues that I would like to discuss, but since time is short, I will confine my remarks to three. These are as follows:

1. Characteristics of small farms
2. Farm management and farming systems research

3. How to help small farmers

Characteristics of small farms:

What is a small farm? All three papers mention it. Dr. West in particular looks at different definitions of them in the United States, while Dr. Vincent suggests that in the developing countries small farms are generally subsistence farms with a great deal of reliance being placed on use of family labor. I hope that we won't spend too much time trying to define what a small farm is. I think that most of us would accept, in general terms, how a seminar sponsored by the Agricultural Development Council characterized small farms; small farms are those with "very limited access to political power, productive services, productive assets, and/or income streams in the society" (Adams and Coward's "Small Farmer Development Strategies," Seminar Report No. 1, Agricultural Development Council, New York, 1972).

The characteristics of small farms delineated by Drs. Vincent and West for the developing and developed world have a high degree of commonality. A partial, but not necessarily inclusive, list includes the following: (a) a great deal of heterogeneity in terms of the farming systems practiced; (b) a close linkage of the farm business to the household consumption unit; (c) monetary and nonmonetary values and objectives of small farming families; (d) limited quantity, and sometimes quality, of resources available for operating the farm business; (e) farming systems that are, in general, not highly specialized, but considerably diverse, therefore enabling complementary and supplementary relationships between crops and livestock to be exploited; (f) major constraints faced by farming families, in terms of land and capital, and often even in terms of labor, due to their limited resources. In addition, difficulty in breaking such constraints due to a low degree of reliance on external support systems; for example, it is often difficult to obtain institutional credit—reasons for this include an unwillingness to shoulder the risk attached to borrowing institutional credit and/or poor accessibility to such sources of credit.

Although I may be dangerously oversimplifying the U.S. situation, it seems to me that there are two types of small farmers in the United States. There are those who have small farms for recreation or simply supplementary income purposes, and there are those who have a more serious orientation, in the sense that they depend upon agriculture for a major source of income—if they work off the farm it is more a question of necessity rather than choice. It is with reference to the latter type of U.S. farms that a greater degree of commonality exists vis-a-vis small farms in developing countries. It is also these types of farmers whose problems we are addressing in this conference. Does the commonality of characteristics and, hence, problems of small farmers in developing countries and "serious" small farmers in the United States mean that ways to help small farms in both areas of the world are the same? I will return to this question later in the discussion.

Farm management and farming systems research:

Dr. Johnson, in his keynote address, wrote a very profound and poetic sentence: "Those who ignore history must relive the painful experiences of the past." This sentence refers to his contention concerning the similarity of farm management that was practiced early in the century in the United States and farming systems research that is currently practiced in the developing, world. His concern is that current FSR is ignoring the contributions of farm management in the United States and Europe and, therefore, current FSR practitioners are in danger of "reinventing the wheel."

I think much of the misunderstanding about farm management and FSR lies with reference to two points: (a) the time frame and (b) the institutions in which FSR programs are currently located in the developing world. Let us look briefly at these two points:

(a) The time frame. The approach is new in developing countries even if it is not in developed countries. Why is this the case? Dr. Johnson talks about three types of change: technical, institutional, and human. The latter has involved paying substantial attention to improving managerial ability. Although some would debate it, I would claim that the early manifestation of farm management as an aid in the ex ante role of developing relevant improved technology has disappeared from the syllabi of current courses in farm management. It is the new characteristics of farm management that are being transferred to the developing countries. Therefore, FSR as it is currently practiced in the developing countries is a product of the 1970s and is new there; it is, perhaps, a throwback to early farm management as it used to be practiced in the United States. Current FSR, as Drs. Price and Hildebrand will indicate in later papers, consists of four basic stages: descriptive/ diagnostic, design, testing, and extension. A multidisciplinary approach that brings together the customers (farmers), extension agents, and research workers is involved in developing and disseminating strategies that will improve the welfare of small farmers. I am grateful to Dr. Sjo for pointing out to me the possibility that an implicit FSR approach has been present in land-grant universities because many faculty originally come from farm backgrounds. This has not necessarily been the case in terms of faculty in research institutions in developing countries. Even if such individuals come from farm backgrounds, they have been inculcated with the notion that small farmers in developing countries are primitive and backward; for this reason alone, an explicit FSR approach is necessary to address the problems of small farms.

(b) Places in which FSR programs are located. Farming systems research programs are located mainly in agricultural research establishments largely dominated by technical scientists. In his paper, Dr. Johnson places a good deal of stress on the international Agricultural Research Centers. A great deal of FSR work is currently undertaken in national research centers. As Dr. Vincent mentions; FSR programs tend to be circumscribed by the mandates of agricultural research establishments. Not surprisingly, there has been a strong emphasis on technical change. In addition to questions pertaining to the mandate of the institution, there is a problem of credibility vis-a-vis the technical scientists. The situation is very different from the early days of farm management—people now in the farm management area in developing countries have to prove their credibility, which is, perhaps, a legacy left from farm management moving away from the technical sciences many years ago in the United States. I don't deny that FSR practitioners shouldn't learn from earlier and, indeed, later farm management work in the United States.

In spite of Dr. Johnson's comments, I would claim that greater consideration is now being given to institutional and policy issues in developing countries. For example, IRRI, ICRISAT, and even CIMMYT are moving increasingly towards using an interventionist rather than a submissive approach to issues of institutions and policy. This change has happened within the last two or three years. Consideration of these issues is particularly relevant within national programs. The project in the Philippines that Dr. Vincent has been associated with has paid a great deal of attention to the institutional issues. As Dr. Johnson points out, in the 1960s and much of the 1970s, a great deal of emphasis was paid to macro-issues. I think those of us working within technical research institutes over-reacted and became very "micro" in

orientation. I would agree with Dr. Johnson that we have to move increasingly towards each other and increasingly address the micro/macro link.

I believe that FSR practitioners have been least successful in dealing with the human change issue even though a great deal of lip-service is being paid to it.

Farming systems research is under some pressure to incorporate more variables in its research process. I don't disagree particularly with the conceptual desirability of doing this, however, I am concerned about the practicality of making FSR more complicated. As Dr. Vincent points out in his paper, it is important for FSR practitioners to develop simple methodologies that can be implemented at low cost. The more holistic the approach, in terms of making more components of the system variable, the more complex the methodology will be, and the more expensive it will be to carry out. Somewhere, hard decisions have to be made about trade-offs.

How to help small farmers:

It is interesting that Drs. Vincent and West stress two different types of emphasis in programs for helping small farmers. Dr. Vincent notes the significance of relevant technology development in developing countries, while Dr. West stresses institutional changes and programs to improve managerial capacity, i.e., human change. Therefore, we return to the issue raised by Dr. Johnson in his keynote address. I have already briefly looked at the criticism by Dr. Johnson concerning FSR work in developing countries, which currently has a great deal of emphasis on technology developments. He suggests that increasing attention should be given to institutional and human change issues. Does not the same argument apply to the developed countries?

Dr. West suggests early in his paper that new technology in the United States has, in recent years, often required major inputs of capital and is, in fact, more often adapted to large units of land. Would just working on institutional and human changes in the current situation simply result in some small farmers becoming bigger at the expense of other small farmers? In other words, does technology need to be developed that is applicable to small farms rather than simply advising the use of technology that was adopted thirty years ago, as Dr. West mentioned in his talk? If the society decides that small farms need to be preserved in developed countries, then presumably their true viability will only be achieved if current emphasis on institutional and human changes is supplemented by a good dose of the farm management of the 1930s—the major thrust of current FSR in developing countries.

SESSION I QUESTIONS

Comment directed to Glenn Johnson:

Your presentation emphasized the similarities and relationships between farm management and FSR; in fact, you implied they are synonymous. We have problems with farm management economists trying to consume FSR, just as agronomists are trying to consume cropping systems when, in fact, FSR should be multidisciplinary. Farming systems must be more than economics; it must include sociology and cultural anthropology, as well as agricultural production (crops and livestock), with extension methodology and the two-way transmission of information between farmers and researchers.

Response :

Both farm management and FSR have experienced difficulties when any one department or discipline has attempted to dominate them. The domination of farm management by production economists narrowed a multidisciplinary subject unduly to a subpart of only one discipline. Farm management has, and FSR is experiencing, this difficulty. I once wrote an article on this subject, entitled "Agricultural Economics, Production Economics and the Field of Farm Management" (Journal of Farm Economics, 39(2), May, 1957, pp. 441-550), proposing that farm management be administered from the dean's office so that appropriate combinations and contributions from the different departments in the college could be arranged.

Question directed to Glenn Johnson:

You emphasized the importance of developing the human resource in developing countries. In the United States, where most farmers have had considerable formal education, how important is developing the human resource in research and extension work with small farmers?

Response :

In my judgement, investing in the human resource becomes more and more important as a country develops. The human resource is probably relatively more important on small than on large farms.

Question directed to Glenn Johnson by Jim Converse, Department of Sociology, Anthropology, and Social Work, Kansas State University, Manhattan, KS:

In saying we need to look at the costs of distribtion and redistribution, as well as the supposed beneficiaries, what does this tell us about smaller farmers who are being forced out as a result of other farmers' expansion?

Response :

I believe this question refers to the redistribution of the ownership of income-producing resources. Not all farmers leaving small farms are forced out—many leave gladly and voluntarily because they see better opportunities. I hope you are not inferring that disadvantaged farmers on small farms be prevented from taking advantage of better opportunities. If we want to maintain disadvantaged small-scale farmers in agriculture without subsidies and force, it behooves us to redistribute the ownership of income-producing rights and privileges to them. I refer to such things as new technology,

better education, subsidized credit, capital grants, and improved terms of exchange. One of the difficulties this creates for the defenders of small farms is that once a small-scale, poor farmer acquires ownership of enough resources to no longer be poor, he becomes at least a medium-sized farmer.

Questions directed to Glenn Johnson:

Farmers are producers and operate businesses like their industrial and city merchant counterparts; traditionally, however, they had to buy at retail and sell at much less than wholesale. How does the samll farmer get around this problem, since most states do not grant them the purchasing benefits of local town merchants—that is, a merchant's license or equivalent?

Response :

Small-scale farmers produce small quantities of products. As assembly costs for small quantities are high, small-scale farmers sell at a disadvantage. Similarly, small-scale farmers buy small quantities of inputs. As distribution costs for such small quantities are high, small farmers also buy at a disadvantage, High assembly and distribution costs must be paid by someone. Even if a group of small-scale farmers forms purchasing and marketing co-ops, the co-ops encounter the same high costs of assembly and distribution.

The above response at the conference caused the questioner to suggest retailing on the part of small-scale farmers. The small-scale farmer who retails must still bear the cost of assembling and/or distributing his product, either to individual urban households or to a self-operated roadside stand. The costs of such assembly and distribution are still high when the small-scale farmer does it. The difference, however, is that he now receives these costs. In effect, he expands the size of his operation by adding the function of marketing to his basic production activities. Typically, both his gross and net incomes increase, though the return per hour for the extra work he and his family do may be low.

Question directed to Glenn Johnson:

In discussing activists, Professor Johnson mentioned that they operate at times on the basis of misinformation and often further information that is simply wrong. Could he give some specific examples of the things he discussed generally?

Response :

On the second page of my paper, I discussed the work of Perelman, Lapp and Collins; George; and Nelson. Nelson sees a gigantic conspiracy among large-scale farmers, the land-grant institutions, and agribusiness to drive small farmers out of farm employment. I seriously doubt the existence of this conspiracy, and I do not think Nelson is prepared to demonstrate its existence. Still further, I do not find that the authors cited generally face up to either (a) the high cost of maintaining small-scale farmers with subsidies or (b) the implications of forcing small farmers to "stay down on the farm," rather than permitting them to (a) migrate to better opportunities or (b) expand to become large enough to produce the levels of income earned by other members of society.

Question directed to Glenn Johnson by William Edwards, Iowa State University, Ames, IA:

Should a "farm and home" emphasis in research/extension programs in the United States be revived? If so, what are the prospects? What should be changed from the 1950's approach?

Response:

I believe that a farm and home emphasis should be revived in the land-grant research and extension program, particularly in states with limited-resource farmers. In states with large-scale, efficient, commercial farms, the maintenance of separate programs dealing with production and household matters implicitly recognizes the validity of the farm/home development approach even though responsibility for integrating the production and home management extension is left with the families.

I believe the prospects for such a revival will be fairly good as farming systems matures through the different stages farm management went through earlier, given the present interest in small farms. The most important thing is not to let farming systems and the work on small farms be co-opted by any one group, i.e., the agricultural economists, the biological and physical scientists, rural sociologists, or the home economists. College-level administrative action will probably be needed.

Another related point, which I touched on in my paper, has to do with the inability to distinguish between the firm and the household on the basis of profit versus utility maximization in a dynamic environment. The expected utility hypotheses and most treatments of decision-making on the production or profit-making side involves maximization of utility, as well as profits, on the part of production managers. Insuring and chance-taking decisions are made by maximizing expected utility, not expected money profits. Further, on the household side, I estimate that the typical family household produces goods and services that would be worth $20,000 to $40,000 annually if priced on the market. Thus, households are major producing enterprises as well as consumer units.

In the ’80s, I believe that the traditional static distinction between the firm and household should be dropped and that a form of dynamic decision-making should be taught to both farmers and homemakers, even in states with large commercial farms. This dynamic decision-making should consider maximization of non-monetary values. Teaching such decision-making would require objective attention to non-monetary as well as monetary values.

Question directed to Glenn Johnson:

(a) In your presentation, FSR is shown to be nothing new, but simply a return to previous approaches in agricultural economics. But new FSR is so highly integrative across disciplines that it cannot be conducted within any given dicipline, rather, it is a shared methodology, with shared hypotheses by several disciplines. I don't see this in past approaches.
(b) Also FSR is not simply the adaptation of recommended or otherwise proven technology to farm conditions, rather, it is original, basic research on new phenomena conducted on farms because this is the best laboratory for it.
(c) Please explain the meaning of "limited" resources, and give some example of research on farms with unlimited resources.

Response :

Farming systems research stresses integration across departmental and/or disciplinary lines. Traditional farm management research originated in a similar attempt to integrate across disciplines. My fear Is that the farming systems approach will suffer the same fate as traditional farm management and be co-opted by some one department or discipline. In my presentation, I indicated that farm management was multidisciplinary and that earlier attempts by economists to make farm management a subpart of economics were mistaken. Certainly economics is not broad enough to absorb either traditional farm management or the farming systems approach. The same is true of the animal sciences, the crop sciences, and sociology.

I agree very much with what you have to say about shared methodology and shared hypotheses by several disciplines, but do not think it is new. At my own university, Ray Hoglund long did research in cooperation with the dairy farmers of Michigan and in cooperation with the dairy scientists, the agricultural engineers, and the soils and crops people long before the farming system terminology evolved. Hoglund was not the first one to do it at Michigan State or elsewhere, and he is not the last. Shared methods and hypotheses were a part of traditional farm management, which was partially (but not entirely) lost. The farming systems approach is not unique in this respect; however, I believe the farming systems approach, like traditional farm management, is already in danger of losing its shared methods and hypotheses.

I also-agree that farming systems work can be original research and that the farm is a good laboratory in which to conduct it. I do not agree, however, that this aspect is new with FSR. In this connection, see Hoffnar and Johnson's, "Cooperative Agronomic-Economic Experiments at Michigan State University" (Michigan Agr. Exp. Sta. Res. Bul. 11, 1966, pp. 60-101).

I use the term "limited-resource farmers" to refer to farmers who own so few income-producing rights and privileges that they cannot produce enough income to permit them to keep up with the rest of society. The term does not originate with me. The opposite term "farmers with unlimited resources" is not very meaningful. It must mean farmers with enough resources to produce enough income to keep up with the rest of society. It certainly does not mean farmers with infinite resources. All farmers, both those with adequate and inadequate incomes, face resource constraints.

Question directed to Glenn Johnson:

What is the linkage, if any, between the recognition of normativism as a foundation of all science and the role of activists, i.e., the World Council of Churches?

Response :

This question is a good one. I believe there is an element of normativism involved in all science, even that of the so-called hard sciences. Many philosophers of science agree on this point, particularly the pragmatists and the "post-logical positivists." As space available here does not permit full development of the relevant arguments, I will just accept the premise that normative knowledge is an essential accompaniment of positive knowledge in most sciences. Food and small farm activists have participated more in the U.S. Council of Church activities (to my knowledge) than in the World Council of Church activities. Activists play a constructive role by putting

important normative issues and questions on the agenda. My concern with them is that they seldom handle either positive and normative knowledge or decision-making roles in a constructive, objective manner in developing their recommendations as to what should be done to solve problems involving the values and issues they call to our attention. I recently commented to a churchman concerned about the church's inability to carry out recommendations of church activists by stating that "God acts in mysterious ways and we should be grateful He frustrates some of the poorly thought out recommendations of some of our church activists."

Question directed to Glenn Johnson:

Please cite a few references (anything) that provide valuable information on interpersonal welfare comparisons.

Response :

I am relatively hard-pressed to find good references on interpersonal welfare comparisons. I have been told that Schmitt at the University of California is doing some good work in this area. I would also cite the work of Karl Fox at Iowa State University on social indicators. There is a recent study of normative and prescriptive information included in the Department of Energy's mid-range energy forecasting system done by Judith Brown and myself which I cited in my paper. The dearth of good studies and active authors in this area can probably be traced back to (a) positivism, which asserts that there is nothing objective to be known about the normative—which is either personally or interpersonally valid—and (b) Pareto-optimality, which also posits that there is no interpersonally valid normative knowledge.

As we outgrow the constraints of now defunct logical positivism (see The Legacy of Logical Positivism, P. Achinstein and S.F. Barker, eds., The John Hopkins Press, Baltimore, 1969), there is reason to hope that we will have more articles and authors reporting interpersonally valid welfare research. Without such knowledge, all attempts at reforms that damage some people in order to benefit others must remain arbitrary and unobjective.

Question directed to Glenn Johnson:

You appear to place relatively low value on land reform. Doesn't this fly in the face of conventional wisdom? Would you expand on your position? Why do you feel as you do?

Response :

My concern with reform has to do with the redistribution of all income-producing rights and privileges. In earlier days in the West and in some current less developed countries, land was the dominant income-producing resource. In still earlier days, labor was ordinarily tied to the land by feudalistic arrangements. In modern societies and in many developing societies, I believe that ownership of the right to the income one's own labor can generate is now more important than ownership of the right to benefit from the income generated by land. As technology improves and as greater skills are involved in using advanced technology, the ownership of education and training becomes relatively more and more important than the ownership of land in determining incomes. Sti11 further, as capital accumulates in a society, the distribution of the ownership of the right

to receive income from accumulating capital becomes increasingly important, In the United States, income generated by land is relatively unimportant compared to the income generated by physical and human capital. I am much more concerned about who owns the human and physical capital of the United States than I am about who owns the right to benefit from the income generated by land.

Question directed to Glenn Johnson:

(a) Glenn, you did a good job in bringing us up to date on farm management and FSR, but you did not address any comments on current farm management programs that are addressing problems relating to firm/houshold problems, such as the Family Farm Development Program (Missouri). It is not titled FSR, but it does address some of the issues you raised that need to be researched. I am sure there are other such programs that are not getting attention because they are not using the buzz word "FSR." (b) Is FSR so different from farm management that FSR should be a dicipline different from farm management? Are we spending too much time defining a new system approach and not doing enough with what we have already developed?

Response :

I think there has been a tendency for current farm management programs to become specialized in economics and that many such farm management programs lack the breadth of the Missouri Family Farm Development Program. In some sense, the farming systems approach Is a return to traditional farm management researchers unduly oriented to production economics. I must hasten to point out, however, that there have been, and are, many farm management extension workers (who have not become unduly specialized in production economics) who maintain close working relationships with other departments in colleges of agriculture and who participate in the programs of those departments. Also, from time to time, an experiment station director or a dean of agriculture "takes the bull by the horns" and insists that all of the relevant departments in the college or experiment station address a particular issue or problem. When this happens, we have something like more traditional farm management work and like what is currently called the farming systems approach. I do not think that either traditional farm management or the farming systems approach can become a discipline or even a department in a college of agriculture and still maintain the essential holistic, multidisciplinary approach to problem-solving. I should note, incidentally, that most of the departments in a typical college of agriculture are not disciplines in the sense in which a discipline is conceived in a traditional university. An agronomy department, for instance, is more of a multidisciplinary institute involving soil chemistry, soil physics, soil bacteriology, genetics, botany, and biology than a disciplinary department of a traditional European or U.S. university, Such a department or institute concentrates on producing knowledge about soils, the nutrition of plants, the growth of plants, and the improvement of the genetic capability of those plants. If we were to attempt to make a traditional kind of discipline out of FSR, we would kill it.

Question directed to Glenn Johnson by E.E. Hegen, Department of Geography and Geology, Western Kentucky University, Bowling Green, KY:

Is not one of the basic characteristics of small farms (at least in LDCs) a large labor force of children and/or extended family units? How does FSR

deal with that; has work been done; and how does this "human capital" fit into improvement planning?

Response :

Professor Vincent has already responded to this question. I would only add that not all small farms possess a large labor force. Some farms are small because they possess little resources of any kind, including labor. Still further, some small farms with small labor forces are still "smaller" because the labor force is of low quality. I am thinking of small farms populated by the aged, the infirmed, and the handicapped. In some instances, investments in human capital can do much to improve the quality of the labor force, thereby increasing the totality of income earning resources on small farms.

Question directed to Warren Vincent:

What are some practical ways to fuel the development of the small farm or... what can be, done to solve the "capital limiting situation" of small farmers?

Response :

I do not claim to be an expert in matters having to do with the financing of agriculture in developing countries, but I will stick my neck out with the following assertions that I think are aspects of the "capital limiting situation" that you mention:

1. For the family farm bordering on subsistence, family consumption requirements and expenditure behavior are of primary importance.
2. Production decisions and actions are means to the end of meeting consumption goals and do not constitute goals for their own sake.
3. Institutional credit is typically tied to input-output expectations, for single commodities are production-oriented and do not recognize complex household-firm interactions nor temporal risk considerations for the enterprise being financed.
4. Cooperative organization for production financing along commodities lines has met with limited success.

Although it may seem "impractical" to you, I believe the key to your question lies in the phrase "development of the small farm." This implies a better understanding and diagnosis of farm households and farming communities as functional and interacting systems and the design of interventions based on this understanding and diagnosis. This should speak in favor of more efforts along the lines of FSR.

Question directed to Warren Vincent:

To develop their nations, LDCs face a dilemma: assist small farmers—they form the bulk of their populations and are considered as efficient and good resource allocators. Since this is very costly (in terms of farm credit or payments of researchers and extension agents who have the task to make available new inputs to these small farmers), given that no returns are expected from the self-subsistence farmers, how do we solve the dilemma?

Response :

In some LDCs this dilemma has been resolved through socialism. Is this a good solution? Your first premise reminds us of the condition "efficient, but poor" typically assigned to the small farmer. It is not only LDCs that direct research and extension to farms having the greater potential for development at the exclusion of the "poorest of the poor." Some argue that the latter group should be addressed through direct income transfer programs rather than through programs of agricultural development.

Question directed to Warren Vincent by Serrano Segundo, Ministry of Agriculture, Philippines:

Small farming systems in LDCs are evidently influenced by factors such as technical and economic soundness, acceptability by farmer and society, management feasibility, and strong political will or legitimizer's support. Collaboration or congruence of all these factors may be difficult to bring about. What degree of harmony, collaboration, or congruence is necessary to have FSR output be meaningful for the end user—the farmer? Is it necessary to work out some degree of harmony/collaboration/congruence before undertaking FSR? Or is this area of collaboration researchable in itself, particularly for centralized and decentralized governmental set-up?

Response :

The problem you pose is particularly acute for projects funded through bilateral government agreements. Negotiations may need to be bent to meet the legal requirements imposed by the donor government for loans and/or grants. As you infer, problems in implementation arise if "harmony, collaboration, and congruence" do not exist. Since FSR projects are location-specific and require rather intimate interactions with the project participants, I believe much care is required in the project design. Specifically, the Project Paper should already entail considerable ground level support, and matters of site selection and description should be settled before it is submitted for final approval by the donor. The technical, economic, and social soundness of an FSR project should deal very specifically with an already identified target population and implementing agency in mind, and with their inputs recognized in the project paper. Hopefully, this would minimize the potential problem areas. This is not to suggest that there is no room for research on the issues of collaboration that you have intimated. Such research could be very useful, assuming their are monies for its support.

Question directed to Warren Vincent:

Is not one of the basic characteristics of small farms (at least in LDCs) a large labor force of children and/or extended family unit? How does FSR deal with that; has work been done; and how does this "human capital" fit into improvement planning?

Response :

Ideally, FSR involves a careful assessment of the resource conditions faced by farm families in the designated area for research and development. The relationship between the family (its size, age, composition, skills, etc.) and the land resource is part of that assessment. Despite a typically high ratio of family labor supply to land area in LDCs (compared with

industrialized nations), there are still critical periods when many families are unable to accomplish necessary tasks with available family labor. These critical periods may call for exchange labor arrangements, hired labor, technology adjustments, and, in some, utilizing members of the extended family who may reside outside the immediate community. These issues have bearing on crop cultural practices carried out by farmers and their willingness to adopt "packages" of technology. In short, the condition you describe is relevant to research in agricultural technology. Also, a full consideration of the household situation would give attention to the full range of strategies employed by small farmers to fulfill their goals as best they can; these include off-farm employment in the community, non-farm cottage industry type enterprises within the family, and the importance of remittances to the household from family members employed outside the community.

There is nothing in the FSR methodology that prohibits consideration of these issues. As we have pointed out before, whether or not they will be considered adequately will depend on many factors, including the goals of the government, the implementing agency and the project donor, the duration and scope of the project, and the make-up of the researchers who participate in the FSR effort.

Question directed to Warren Vincent:

Would you address the topic of rural/urban migration as related to affects on small farms in LDCs? Do you foresee an option for LDCs' governments to use small farms as a resource to further an equitable spatial population distribtion?

Response :

The bulk of the population of most LDCs reside in rural areas, and much of this rural population attempts to make a living on small farms. Even though the agricultural labor force is fully utilized in some periods of the year, there are many weeks of the year when income generating opportunities are limited and underemployment, if not unemployment, are dominant futures, especially in rainfed areas. Education stimulates new wants and frequently alters value systems to seek higher education degrees, which favor white collar or blue collar employment over farm work. Some governments encourage migration to wealthy countries for relief of local poverty and to generate national income from foreign remittances.

Your question implies that equitable spatial population distribution is in some way better than inequitable spatial population distribution. Our concern is probably more with equitable distribution of economic opportunity than with equitable population distribution. The cities are incapable of providing opportunity for a very high proportion of rural migrants. Therefore, development planners seek ways not just to "keep the boys down on the farm," but to create improved economic opportunities for the total population. I don't know for sure what it means to use small farms as a resource to further an equitable spatial population distribution, but I am quite sure that we would agree that rural to urban migration would be reduced with an improvement in the economic conditions for small farmers.

Question directed to Warren Vincent:

Your summary addressed the "methodology" of tailoring programs to local

situations and the unanswered question of micro vs. macro. My experiences indicate that any real program progress is dependent upon this cooperation of government between the national (ministry) and the local (the farmer), i.e., the provincial and district levels, where any real operationalizations of programs must take place—it seems that it is at these intermediate levels that incentives, real perceptions of opportunity for improvement, as well as physical help (access to markets, transport, etc.), must be generated. Do our programs, proposals for aid, etc. address this intermediate level of government and related agencies?

Response :

I suspect your experiences qualify you for as good or a better answer to your question than I can provide. Nevertheless, my experience would support your observations. The research of participation to effective rural development...my overseas experience has been in a political environment where "top-down" policies were formulated and "top-down" programs and interventions were conducted. The intermediate levels of government to which you refer were links in the chain of command. The farmers were regarded as recipients rather than participants. Furthermore, most programs were administered in a linear fashion from a single government agency to the field with the potential for several parallel interventions through intermediate governmental bodies with little inter-ministry cooperation/collaboration. In Asia, however, I have observed a move toward decentralization of administration from national to regional units. This should help to make programs somewhat more sensitive to local need. Nevertheless, with a conference such as this one, composed of FSR proponents, we would have little difficulty in coming to agreement that a farming systems approach has the potential for overcoming some of the shortcomings of the "top-down" approaches of the past.

Question directed to Jerry West by Eric Lombardi, Department of Technology and Human Affairs, Washington University, St, Louis, MO:

Regarding rural-urban drift of the American youth, I believe this is a reflection of dissatisfaction with life in general in the rural communities, where both economics and lack of social amenities are important. I am concerned with the future if the trend continues in which urban social and cultural amenities are perceived to be superior to the rural "good life." What does this say to the future of the American small farm?

Response :

The data show that the small farm is not disappearing, but, rather, it is the middle-sized farm that is disappearing. Rural youth have left the farm for both economic and non-economic reasons. However, the turnaround in population in most rural counties during the 1970s indicates the population does not necessarily consider the rural area as an inferior place to live. Admittedly, the Great Plains region did not experience this turnaround to the same extent, but even if rural areas do suffer from lack of social amenities as well as economic opportunities, this just emphasizes the need for well-rounded rural development programs and not simply emphasis on small farms.

Question directed to Jerry West by Jim Lukens, Department of Agronomy, Kansas State University, Manhattan, KS:

While the importance of the community in which a small farmer in the United States operates was mentioned in terms of providing opportunity for off-farm employment, other factors within the community are also important in terms of support mechanisms. As a small farmer in Kansas, I find myself concerned about the declining quality of life due to loss of neighbors, as well as concerned about maintaining economic viability. I find a potion of my desire to remain a small farmer stems from the feeling that my (or other farmers) becoming bigger necessarily means that my neighborhood will become less populated, and, thus, a less fulfilling place to live. Don't other social institutions and structures on the local level need to be included in the total analysis, in addition to the economic framework of the community?

Response :

Yes, the size and density of the population in rural areas does affect the quality of life. Hence, efforts to make the small farmer more viable, as well as provide other job opportunities, become important as a means of maintaining the population at some desired level.

Question directed to Jerry West by Dean McGraw, Extension Horticulture, Texas A&M University, College Station, TX:

Do you feel that the psychology or state-of-mind of small farmers, especially vegetable farmers, has a marked influence on marketing, i.e., a small producer often feels that the buyer is doing him a favor?

Response :

Yes, the level of knowledge, information available, and the attitudes of the small farmer affect his approach to marketing; they affect his willingness to innovate, to incur risk, to experiment, and to work with other farmers in seeking solutions. So these factors must be considered along with the resources available to the small farmer and the ability to survive when undesirable results occur.

Question directed to Jerry West:

Given that the objectives of small farmers do not always rank similarly to those of larger, profit-oriented farmers, why should we be so concerned with investing large sums of taxpayers money into research that is not beneficial to medium and larger producers?

Response :

The reasons for attempting to meet the research and education needs of small farms would include the following: (a) a concern for the large number of families involved—families who need additional income and who would benefit from more assistance; (b) a sizeable quantity of resources involved, which, in many instances, are not used as productively as they might; and (c) a matter of equity—our research and extension system in recent years has been of more benefit to the medium-sized and larger producer; some work oriented more toward the benefit of the small farm would be a move toward greater equity, not less.

Question directed to Jerry West:

I understand that small farmers have less access to resources and are, therefore, less able to make changes in their farming systems; however, Dr. West states in his paper that "small farmers are not as motivated to seek information or make changes in the farming operation as are larger farmers." Would he please describe the research experience that led him to make this statement.

Response :

Perhaps "incentive" to seek information or make changes would have been a better use of words than "motivation." Certainly the small farmer wants to improve his or her situation and is rational in choosing to take action or not take action. However, since the size of the operation is small, it may not be worth the time and effort required to assemble information, evaluate the alternatives, and implement a new approach. There may also be trade-offs involved—the prospective gain may not be worth the risk, or change to a practice that will provide more income from the farm may take time away from the non-farm job or the family. I simply meant to suggest that these trade-offs must be recognized when we are trying to bring about changes and when we are designing programs.

Question directed to Jerry West:

What kind of lobbying is needed to save the "Class 1 farm land" that the small farmer utilizes? In regard to foreign investors of farm land, what is the solution to keeping our land in agriculture?

Response :

Since, as a nation, we have not prevented purchase of land by foreign investors and have allowed diversion of prime farmland to urban use, highways, recreation use, and other non-agricultural uses, it is doubtful if we would restrict ownership and use of prime farmland by small farmers. Rather, a more likely approach to avoid losing this land to non-production use is to work with the small farmer so that it will continue to be used for agricultural purposes.

Question directed to David Norman by Norman Uphoff, Rural Development Program, Center for International Studies, Cornell University, Ithaca, NY:

You summarized "types" of small farmers in the U.S. as "hobby" farmers and "serious" farmers. The latter characterization implies full-time farming and also farm units that are economically "viable." In LDCs, may we not need to reconceive small farms as support and security bases for more diversified economic strategies of small farmers?

Response :

I perceive serious small farmers as those whose major occupation is farming; they may earn off-farm income as a matter of necessity. Therefore, I agree with your second observation about farms in LDCs.

RATIONALITY OF FARMING SYSTEMS PRACTICED BY SMALL FARMERS

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Small farm systems are complex, and to some degree that complexity is a result of interdependent factors in the physical, biological, economic, social, and political environment in which the farmer finds himself. Rationality of, farming systems should really be considered as the rationality of small farmers in their decision-making as a response to the complex factors listed above. This presentation will focus on two basic aspects of rationality as they relate to decisions on the small farm.

First, rationality, like beauty, is in the mind of the beholder. What seems entirely rational (reasonable or sensible) to you may seem completely irrational to me. I propose that most of us who have not been small farmers in any *context* (much less the specific context of one farmer or group of farmers under study) may have great difficulty in beholding the entire set of variables which may interact on one farm. Even with a list of those variables in hand; it would be difficult to understand how the farmer or decision-maker integrates those variables in his own mind.

Second, there are decisions on the small farm which appear rational in terms of one criterion and completely irrational in terms of others. The farmer who clings to diversified cropping systems to feed his family may be nutritionally rational, even though he could plant monoculture soybeans and appear more economically rational in terms of net income for the year. Another farmer may keep five pigs as a part of his mixed farming system because the pigs are needed for a certain festival at the end of the year, even though an economic analysis shows clearly that his cost of production is extremely high, and it is more sound, economically, to purchase five pigs before the fiesta than to raise them. The farmer is integrating all of these complex and often conflicting pieces of information as he reaches a decision to pursue a certain course in the design of his cropping and farming systems.

Further, the goal of this discussion of rationality is a better understanding of decisions and small farm systems in order to introduce change, make systems more productive, and seek alternatives that will lead to a better life for the family. The focus on development is that of Harwood (1979):

> "Farm development as used here signifies a progression to more efficient and more productive use of limited farm resources. It nearly always implies an increase in labor productivity and an increase in quality or quantity of food and fiber output of a farm unit. In the early growth stage, in particular, it probably will not involve commercialization."

Thus, we reject, as sole criteria for measuring change, the agronomist's "maximum, yield" or the economist's "maximum net return." Instead, we seek some nebulous integration of these and other criteria into some improvement in way of life.

It is necessary to approach rationality from a series of different directions and to integrate, when possible, the physical and biological factors with those related to people and the societies in which they live. This is difficult to do objectively after years of training and experiences that are discipline-specific and unique, causing each of us to look at the world in a certain way. We even have problems communicating across discipline or department divisions because different jargon and terms of reference are used. Within these constraints, I will attempt to discuss rationality as it relates to the physical, the biological, the economic, and the social environment, without any pretext that these do not interrelate in more ways than we can possibly perceive in a given farm situation.

Physical Environment

Principal factors in the physical environment that influence success in crop production include land, light, energy, temperature, wind, air, water, nutrients, and such catastrophic stress conditions as an excess or deficiency of any one factor, e.g., floods, typhoons, drought, excessive temperatures, late spring frost. Small farms are generally located on the poorer soils in many countries; this problem has political and social roots in some cultures. Whatever the reason, the soil fertility problems facing the small farmer may be different from those which confront a decision-maker in commercial agriculture. A farmer's decision to rotate species, maintain a mix of crops, or include small animals in the farming system may be a rational approach to improving soil fertility in a marginal area. He may decide not to try a new maize hybrid or rice variety if conventional wisdom maintains that new dwarf types require more fertilizer and other expensive inputs. A limited land resource constrains most small farm production, but this is an economic, political, or historical factor.

Lack of water control may limit small farm production potential. Excess rain during the monsoon season and drought through much of the year is typical in most rain-fed farming regions. Larger, commercial farms are more often found in level, lowland areas with potential for irrigation. The small farmer meets this excess/deficiency challenge by planting crops that tolerate excess moisture (rice) or maize on ridges in the wet season, followed by relay- or double-planted crops that extend their cycle into the dry season, e.g., beans, cowpeas and other legumes, soybeans. Crops in the second planting may overlap in growth cycle with the previous crop and mature during dry weather. The farmer is rational in choosing a combination which uses as much as possible of the total available rainfall. To minimize the effects of strong winds, rains, or excessive temperature, the small farmer may spread his plantings over several weeks, he may plant a range in crops species, or he may plant intercrop combinations. These decisions appear to be rational reactions to the rigors of a stressful and uncontrolled physical environment.

Biological Environment

The plant and animal environment in which the small farmer operates is similar in many ways to that of commercial farmers—he is concerned with crop species, competing weeds, and an insect/pathogen complex which interacts with the physical environment. The animal component must be considered, as it involves consumption of both vegetation and grain from crops and return of manure to the land to fertilize the next crop.

Before these factors are explored in detail, I will describe multiple-cropping systems that are common to small farmers in many parts of the

developing world. Considered as the culture of more than one crop on the same land in one year, multiple-cropping occurs in a wide range of variations, depending on climate and component species, dates of planting, and spatial organization of the crops. These intensive systems have evolved in specific microclimates to best use available light, water, and nutrients to produce food for the small farm family and encourage limited commercialization.

In a complex biological environment, the farmer uses these diverse and complex systems to suppress weed growth, buffer his production system from crop-specific disease and insect problems, and more completely exploit available growth factors. A multiple-cropping system covers the ground more rapidly and more completely than a monoculture system; when production is limited by weed competition, this "primitive" system is a rational approach. When a destructive disease or insect attacks a crop, the single species monoculture presents a high risk situation as compared to a diversified multiple-cropping system. Even on a per plant basis, insect attack seems to be influenced by cropping system, with less attack occurring in complex mixtures of species than in monoculture. When two crops are dissimilar in growth habit, root exploration pattern, or total vegetative cycle, these species intercept more total light, use more moisture, and explore a greater proportion of the total soil mass in search of critical nutrients for growth. These factors can be explored experimentally and documented; there are others that have not yet been identified. The farmer is probably rational in resisting a change from multiple-cropping systems to the monoculture system which is often recommended.

Extension activities in developing countries have reflected the conventional wisdom that modern, mechanized monoculture, with inputs of fertilizer, pesticides, and irrigation where available, is the key to increased production and greater efficiency. The small farmer—in his biological and physical environment, with limited land and capital to acquire the additional inputs necessary to make a change—often clings to his traditional system as a way to minimize risk of failure which could result from a specialization in one or two crop species at a higher level of technology. This would appear to be a rational reaction to his variable and often uncontrolled environment.

Economic Environment

The small farmer's tenuous economic situation is one of the most important factors that influence decisions on cropping patterns and farming systems. With a limited land resource, scarce or non-existent capital, marginal participation in commercial activities, and no access to credit, the prototype small farmer is in no position to accept the economic risk associated with a change to a cropping system that requires greater inputs or has any uncertainty of success. Many of his decisions relative to new technology reflect this economic situation.

With limited land to work, the small farmer has little flexibility to experiment with new or untried systems. Such improvements as mechanization or irrigation, which require more extensive land, greater investment, or a cooperative effort among many farmers, may appear unrealistic and out of reach. Although small farms can be more efficient per unit land area through intensive labor and input concentration, the potentials for economy of scale in some activities are often impossible to achieve. The farmer is rational in maintaining his current low level of investment, hand labor use, and current cropping system, and practices to keep risk as low as possible.

Management skills, education, and level of participation in the market economy also influence decisions. Often, small farm family well-being and even survival depend on the regular harvest of a range of crop species from the family parcel. Any change in cropping patterns that restricts production to a single species and concentrates income into one or two short periods during the year may confront the farmer with an economic and management challenge that he is unprepared to handle. Thus, the decision-maker is rational in his resistance to change. It is only through understanding these complex constraints that we can hope to offer rational alternatives.

A number of methodologic steps have recently been taken that will improve our focus on real problems. Elsewhere in the symposium, Hildebrand and colleagues discuss procedures for evaluating cropping systems, production problems, and the farm economic situation that are rapid and superficial, yet useful and cost-effective. The recent interest in farming systems research by Norman, Zandstra, Harwood, Winkleman, and others (and farming systems research/extension by Hildebrand) has brought new credibility to a practical and valuable extension of farm management concepts which, unfortunately, have laid dormant for too many years in places where they are needed most. This re-awakening will help guide our research and development decision-making into approaches that are more relevant to the real farm situation. It is said that one can pick out the experiment stations from 20,000 feet when flying over West Africa because they are so different from the surrounding farms. In a number of development programs, the scientist's rationality is being challenged in ways that will improve his focus on production problems in the context of farm level economic constraints.

Sometimes programs succeed for the wrong reasons. Farmers in the coastal area of Guatemala were eager participants in a credit scheme that provided resources specifically for hybrid maize seed, fertilizer, and pesticides. Although insecticides were useful, they knew that hybrid seed was unavailable and that the maize did not respond to fertilizer. A rational economic move was to sell the fertilizer to nearby cotton growers and use the money to buy contract tractor time for land preparation, and labor to weed and harvest their relay system of maize and sesame. They were rational in choosing which components of technology worked for them, and the government was happy because more maize was being produced. Hildebrand and others in ICTA helped to normalize the recommendations and have credit designated for those components of technology that actually were of benefit to the farmers. What appeared rational and successful to the government was used in a different, though equally rational, way by small farmers to improve net income and production in the zone. These are the complexities of development.

Social Environment

The most complex and least well understood factors in the small farm environment involve local culture, educational levels, social interaction among families in the community, local and regional politics, and national posture toward the small farmer and the entire agricultural sector. New technology that provides a solution to biological problems, an appropriate cropping system for a specific climatic circumstance, or an apparently attractive economic alternative may not be adopted if it does not meet other criteria in the social environment.

Opaque-2 maize in Colombia moved rapidly through the initial breeding activities that led to release of two hybrids in 1969. By 1972, there were

countless regional trials and nutritional studies to demonstrate the biological value of this new genetic material at the small farm level—for the family, for poultry, for. swine feeding. Seed production by the national agency exceeded 200 tons—enough to plant 10,000 hectares, or more than 1% of the total national area dedicated to this basic food crop. To researchers, extensionists, and development planners, this valuable new maize appeared to be a rational and logical change that would be of specific value to small farm family nutrition. In 1973, the program was discontinued. Among the reasons given by farmers for rejecting this technology were susceptibility to insects after planting—and during storage, cost of hybrid seed every season, need to isolate this recessive gene from normal maize, lack of a market for maize with a different kind of endosperm, and changes in method of preparation and flavor when it was consumed at home. None of these problems was anticipated as potentially serious by the research team. The farmer was rational in his rejection of the new technology.

Examples of cultural preference for specific types of food are numerous. IR-8 was a highly successful rice variety that increased production in a number of regions in Asia. Adopted first by farmers with a greater resource base, its impact was marginal on the diets of small farm families who preferred to eat glutinous or aromatic varieties. Many years of research were needed to develop acceptable types. Blackbeans, preferred in Venezuela, Panama, and other coastal or island areas of the Caribbean, have significant insect and disease resistance, drought tolerance, and protein quality advantages over red, white, and multi-colored types. Yet, the market value of black beans is less than half that of the colors in other regions due to a strong taste preference for lighter colors. Small farmers in the Cauca Valley in Colombia glean their soybean fields by hand to recover a product that brings less than five pesos per kilogram; meager income gained in this way is used to buy rice at more than 15 pesos per kilogram. Although there is not direct substitution, some attention to ways of consuming the high protein and high oil soybean, in addition to the cereal diet, would provide better nutrition to the family. Although these examples appear to violate economic or nutritional rationality, the small farmers' decisions are consistent with past experience, food preferences, and cultural factors, which are not usually a part of the plant breeder's or agronomist's equation as he evaluates priorities and designs a research or extension program.

Many constraints on the small farm are a result of national economic or political decisions. The limited land resource may be due to historical factors, and national land reform laws designed to help in redistribution of this resource are frequently ignored by those in power. Concentration of bank and government credit in the hands of large commercial farmers is seen by governments as a way to rapidly increase food production for an increasing number of people in urban areas. Although this is rational and justified to some degree, it ignores the potential for increasing production in the small farm sector and the further complication of urban migration if small farmers can no longer provide for their families in a less than subsistence farming situation. The importation of food grains by the government at a cost greater than the level of subsidy for farmers in that country acts as an economic disincentive for the small farmer; such decisions are often political in nature and are rational only to preserve the status quo of the current government, ignoring the implications to the small farm sector. These examples reflect the complex social, cultural, and political factors that interact with more easily quantified biological and physical constraints that face the small farmer.

Conclusions

A series of examples has been presented to illustrate the range of problems that challenge the small farmer as he makes decisions in his cropping and farming systems. This paper is by no means an exhaustive academic treatise on rationality. It should be clear from the examples that rationality is a matter of opinion, and new technology that appears rational to the researcher or extension agent may not appear so appropriate in the eyes of the small farmer. Further, a decision by the farmer may be rational in biological or nutritional terms, but may appear irrational with respect to economic net return. Such is the nature of decision-making and the nature of rationality of the small farmer.

There is no question about the value of current approaches to improved communication and increased understanding of small farm systems prior to initiation of a research and development program. Farming systems research provides one alternative that appears more relevant and integrating than many of our previous discipline-specific research efforts. The organization and implementation of multidisciplinary teams to better understand farming systems and the broad range of constraints in which the small farmer operates is an emerging model that will prove valuable as we focus on the decade ahead. There are few simple solutions to the global challenges of increased population, need for greater food production, and sustainability of farming systems in a fragile physical and biological environment. It will require all the imagination and dedication we have to meet these challenges.

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FARMER PARTICIPATION IN THE DEVELOPMENT PROCESS

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Introduction

Practically by definition, there will be some kind of participation by at least some farmers in some aspects of planning and/or implementing agricultural and rural development programs. So the question is not whether there is (or should be) farmer participation—such a question is too global and abstract. We need to disaggregate the concept of "participation" and to relate it to concrete situations and tasks.

There are, to be sure, some important philosophical issues associated with the subject of participation, such as whether it is to be treated as a criterion of development, or rather as a means to development. Since such debates depend as much on definitions as on facts or values, however, they need not preoccupy us.[2] Following a time-honored Biblical epistemology, let us seek to know participation by its fruits, and particularly seek to learn from experience.

Some will question whether participation can be effectively increased within a sociopolitical environment that is not favorable. But, as there are examples of relatively effective local participation within non-parliamentary or non-democratic systems, this question also need not bar our further consideration.[3] Macro-issues are beyond the scope of this paper, which presumes that there will be some constraints and resistance in any situation, but that these will not, as a rule, be prohibitive.

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[1] A longer version of this paper was presented to the Second Agricultural Sector Symposium of the World Bank, January 7, 1981.

[2] The strategy of "basic needs," for example, includes participation as one of the essential elements of development, so that it is as much a goal as a means of development. Some would treat it only as the latter. The most reasonable position, in my view, is that participation is analogous to employment. Both constitute means to other valued ends, but are also more than just means, having some intrinsic merit in terms of self-respect, psychological fulfillment, etc. (See Uphoff, Cohen, and Goldsmith, 1979, pp. 279-280.)

[3] Some examples of participatory rural development that are discussed below occurred in a monarchy (Nepal), and also in a country under martial law (Philippines). Moreover, an innovative rural health care project, with considerable planning and implementation through community participation, was initiated in Nicaragua during Somoza's rule. It has been kept post-Revolution with only a change in name. So no a priori conclusions should be drawn about the possibilities of local participation, though we must recognize that the more repressive the regime is the more difficult and problematic this becomes.

There is increasing evidence that non-participatory approaches to development are likely to have limited success, especially in assisting the poor majority. Achieving and sustaining greater participation in conjunction with development activity is nowhere easy or always predictable, but there are good reasons for attempting to promote it because of the contribution such participation can make to the design and operation of better programs, especially with regard to more broadly based benefits.

The Several Dimensions of Participation

Few terms have been as variously conceived and advocated as "participation," even participation within a project context. Not surprisingly, we find disciplinary biases conditioning what different people mean by "participation." Economists and planners have spoken mostly in terms of people's participation in benefits. When viewing the increase in benefits, at least until recently, as mostly a matter of resource investment and optimum allocation, they have usually been indifferent to the means whereby output was to be increased. Their criterion of success was pegged to the amount, and more recently, the distribution of benefits generated.

Project managers and persons working on public administration, on the other hand, have focused on participation in implementation as their chief concern—whether people's involvement in this process can accomplish specific tasks more efficiently. Taking a different tack, political scientists and some politicians would stress participation in decision-making as the crucial mode of participation, with people helping to determine what will be the tasks for implementation and who will benefit from them.

All of these views have some validity, though none are complete or sufficient as an approach to participatory development. While all are important facets of participation, they are not equally important in all situations or all phases of activity. It is necessary to treat each aspect in its own terms, thereby disaggregating the concept of participation, appreciating that each aspect contributes to a holistic process of participation. As a rule, broader participation in any of these aspects is better than having less, but one needs to be concerned also with who is participating in them, and under what circumstances.

Several years ago, the Rural Development Committee at Cornell was asked by the U.S. Agency for International Development (AID) to undertake a review of the literature on "participation" in development and to formulate an analysis that would be relevant to its projects (Cohen and Uphoff, 1977, 1980, pp. 213-236). We concluded that, while the subject was complex, it was also manageable if the term was broken down into specific and concrete components along three dimensions—what kinds of participation are occurring, who is participating in them, and how? The first two can be treated in numerical terms of frequency—how many of what kinds of persons are involved in what activities or aspects of participation? The third is essentially a more qualitative dimension. The three dimensions are depicted in Figure 1.

Two sets of factors affecting the relevance and feasibility of different kinds of participation were also identified within this framework—the project context (what tasks were being undertaken, and within what administrative structure) and the task environment (economic, social, political cultural,

and other parameters). These contextual factors are complicated because of their number and their interactions, which have not been systematically analyzed for their effects on participation outcomes. Discussing what knowledge there is about such factors would be a paper in itself, so they are simply listed in Figure 2, juxtaposed to an elaboration of the three dimensions.

The reader will notice that tie have added a fourth kind of participation to the three stated at the beginning of this section—participation in evaluation. This has been the least considered and least provided for, but it is as valid and often as crucial a form of participation as the others. The four kinds can be seen as something of a participation "cycle" sketched in Figure 3, paralleling the project "cycle" so familiar to development practitioners. Actually, just as the latter is not as neat and sequential as shown in charts, the four modes of participation are not to be found or addressed in rigid compartments, one after the other, particularly because there is at least potential for considerable feedback (white arrows) and for iteration.

Each of these modes itself is composed of many different kinds of participation. For example, there can be participation in initial decisions (what is to be undertaken, or whether anything should be done at all; how will it be done, and by whom; where will the activity take place, within what time frame; who is expected to benefit; etc.), in on-going decisions (whether the activity will continue; how it might be revised; etc.), and in operational decisions (concerning personnel, budget, and related matters). Not all decisions may be practical for broad participation, though usually more persons could fruitfully be involved at each stage and in more ways than they are at present. The point is not to lay down norms or formulas, however, but to identify the scope for greater participation which planners and administrators should at least consider.

Since not everyone can participate in all aspects of a project, and since projects usually aim at involving and benefiting some groups more than others, it is essential to link any analysis and planning of kinds of participation with who specifically participates in them. Our focus here is on "farmers," but development projects may focus on participation by the following:

**persons with low income
**the landless and near-landless
**women and/or children
**underprivileged ethnic groups
**the geographically isolated
**occupational groups, e.g., pastoralists
or any other project-relevant categories.

Such an analysis suggests that focusing on farmers' participation is likely to be too narrow, especially if it carries a male gender connotation. At a minimum, one would presumably want to break down the category of farmers by income or landowning categories. Analysis of the who dimension is intended to sensitize planners and administrators to a dimension of participation too often glossed over with gross references to "people's participation," even if the kind of participation is indicated (which it usually is not). Plans and assessments of participation need to be broken down according to who should, and actually does, participate, since there are almost always wide divergences in the rates of participation by persons with different roles, interests, and endowments.

For most purposes of planning and evaluation, any systematic analysis of these first two dimensions will represent a substantial improvement over

Figure 1. A Graphic Representation of the Three Dimensions of Participation

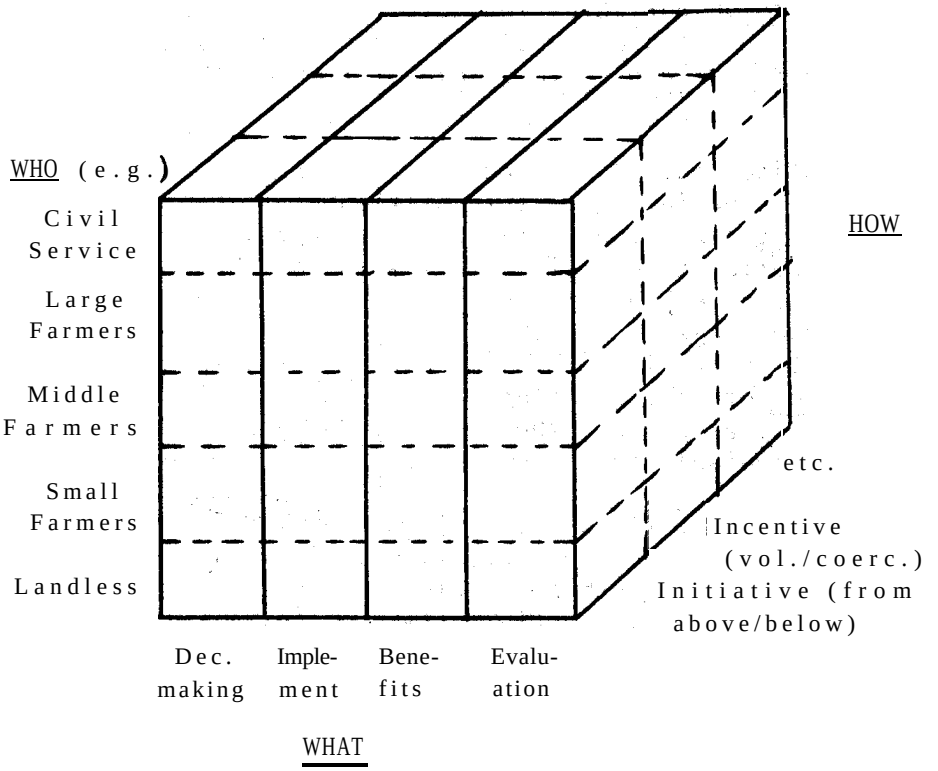


Figure 2. A Basic Framework for Describing and Analyzing Participation

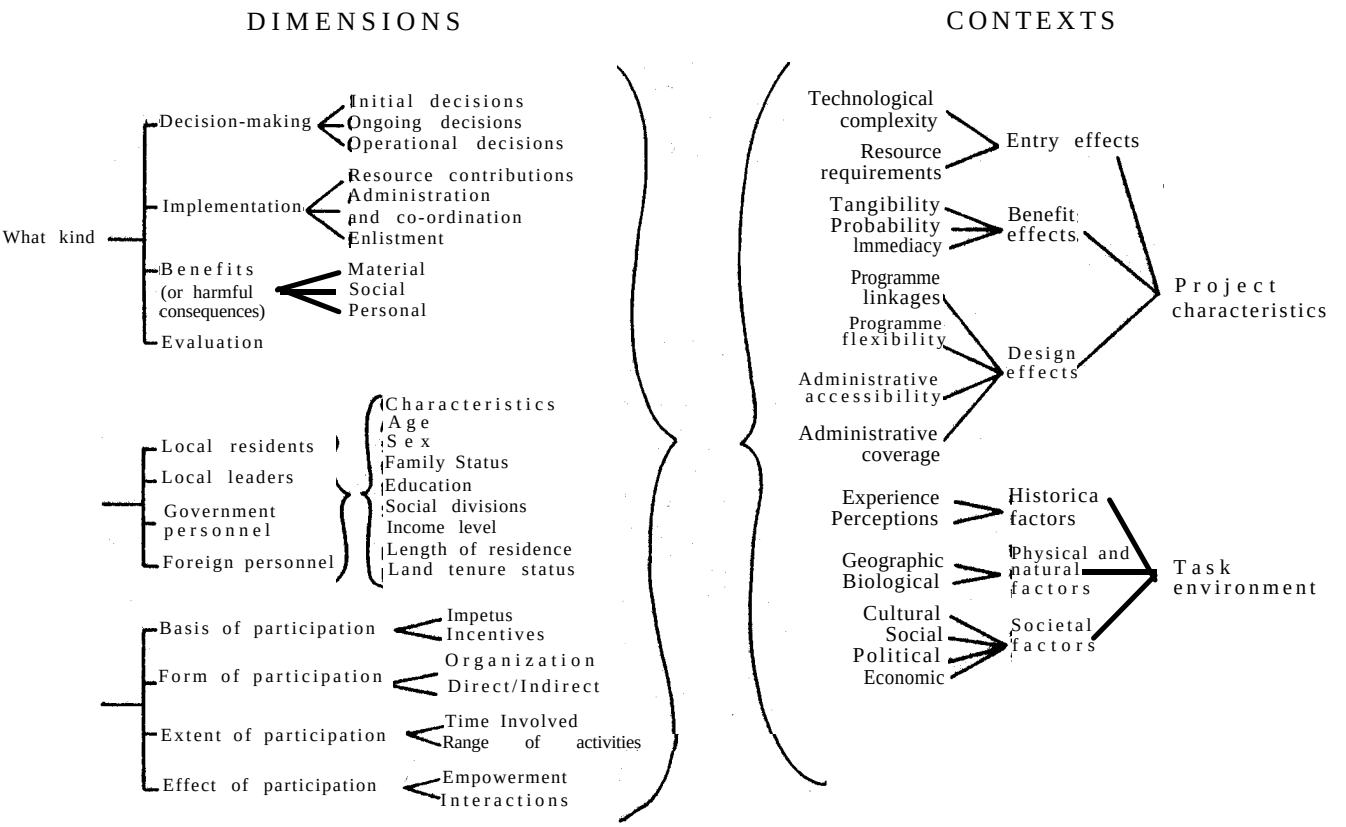
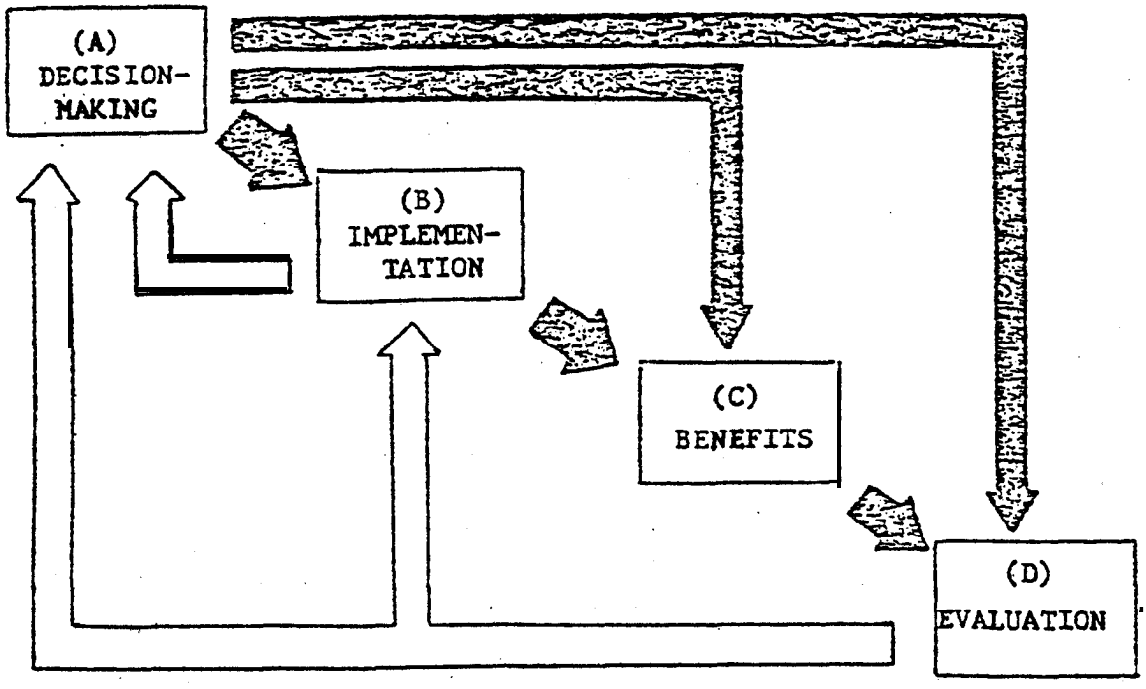


Figure 3. The Four Major Kinds of Participation: The "What" Dimension



present generalities (or neglect). Any serious effort to enhance participation will, however, also consider the third dimension, which includes the following:

**how voluntary or compulsory is the participation?
**how self-initiated or imposed is it?
**how continuous or intermittent is it?
**how organized or individual is it?
**how direct or indirect is it?
**how broad or narrow in scope?

These variables are not reducible to a single measure and are liable to various value judgements, each deserving attention, but none conclusive by itself.

Even if the how dimension is not as measurable as the other two, changes over time (trends) and differences between groups should be noted and, where undesirable, corrected for if possible. (For a more detailed discussion of this dimension, see Cohen and Uphoff, 1977, Chap. 4.) Obviously, the analysis proposed is not to be done mechanistically or routinely, but rather with some imagination and sensitivity to what is possible and what is desirable. The nature of participation leads us in this direction, whether we like it or not. More precise measures and methodologies can surely be developed than are now available, but values and judgements will never be completely divorced from dealing with this subject.

It would seem like an obvious matter to involve various groups of persons, ranging from potential project beneficiaries to government personnel, at least in decision-making about identification and preparation of projects, if not in all technical analysis and financial decisions.[4] But even this kind of participation has usually been limited or omitted in actual projects.[5] Generally, we find that participation in implementation is sought by government personnel, so long as it is implementing the project as planned. Since the project is usually presumed to be "correctly" designed, modifications are too often unwelcome.

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[4] On the matter of economic analysis, one of the persons who has done most to refine and extend it, as a staff member of the Economic Development Institute of the World Bank, is Price Gittinger. In a lecture at Cornell University in March, 1978, he suggested that one of the negative aspects of highly "sophisticated" benefit-cost-and related kinds of analysis was that it had the effect of excluding from project assessments the views of persons who were not so well-trained in economics. Horticulturalists, sociologists, public administration specialists, and others who might have much to contribute, particularly on the implementability of a project and on the validity of assumptions being made, were turned off and turned away by excessive reliance on economic analysis in project preparation, ultimately at great cost to the project. Simpler economic methodology and more stress on technical, administrative, and social factors was thus advisable. This is a very relevant observation with regard to "participation" in the development process.

[5] A case study of what results can occur from failure of project designer to consult fully with government staff in the region (apart from getting some data to put into the documentation), let alone consult the intended beneficiaries, is documented by Chambas (1980).

Although participation in evaluation is eminently desirable in principle, systematic evaluation is, unfortunately, seldom carried out, and then usually in very technical, non-participatory ways. Our third kind of participation—in benefits—is presumably the outcome of other activities, though who will participate in them and how is something to be determined in each case. We must remember that there may be no benefits, or even negative consequences, flowing from a project, so one should not simply assume beneficial outcomes and should be prepared to analyze participation in unexpectedly adverse effects if there are any.

The analytical framework outlined here maps out dimensions and possibilities for greater participation, pointing toward kinds of decisions and actions that could make for more effective agricultural and rural development efforts. Deciding exactly what would be appropriate and feasible kinds of participation must be fitted to particular circumstances and objectives. There are no universal formulas for prescribing participation. But consideration of experience, some more successful and some less so, gives a basis for thinking about and thinking through the approach to participation that will be fruitful.

Some Instructive Experience

The evidence in support of more participatory approaches is still fragmentary, and the impetus for them comes more from the unsatisfactory outcomes of non-participatory approaches than from proven methods for, and results from, more participation. Still, there are an increasing number of cases that show the possibilities for both efficient and equitable development by engaging the ideas and efforts of rural people more fully at all stages of the project process.

Data are not available for assessing the "costs" of taking a more participatory or consultative approach, particularly in terms of time and money, a question often raised to justify more technocratic approaches. The misapplications of expenditure and the long delays in implementation, however, where consultation with "beneficiaries" was negligible or participation superficially provided in project documents, are of sufficient magnitude that the "cost" question loses much of its significance. It warrants more systematic consideration, to be sure, but the burden of proof should not be in proving the "cost-effectiveness" of more participation, but rather of neglecting it.

In this section, I will review some of the experience indicating the potential for more participation, focusing particularly on Nepal and the Philippines, which I know better than most countries. Since Nepal is economically and educationally one of the least developed countries, and since its political system is a monarchy rather than a liberal democracy, it would seem to present a less promising than average environment for participatory modes of development.

Within the Rasuwa-Nuwakot area, where a large integrated rural development project funded by the World Bank is underway with rather limited participation in planning or implementation, there is evidence of considerable local capacity for effective and cost-efficient rural development efforts, particularly as encouraged by the Small Farmer Development Project initiated by the Food and Agriculture Organization (FAO) (Shrestha, 1980). This project helps small farmers form groups of 8-20 members who get credit on a group basis and undertake new productive activities, augmented by social service measures.

Some activities, such as a 20-loom small-industries building in Tupche, are done by a number of these groups together where there are economies-of-scale involved. Construction and maintenance can be divided up among such groups, e.g., 13 small groups have constructed and now maintain an irrigation channel. An impact study found that households participating in project groups; compared with control households in the area, had income more than 50% higher, with remarkable gains in the social service and human resource areas as well, all through activities initiated by the farmer groups, assisted by project-provided group organizers.[6] An IFAD mission to Nepal considered the SFDP approach "one of the best models of participatory rural development in South Asia," calling its work "unusually well-designed and implemented (Pradhan, 1980).

An example of the differences in implementation when a more participatory approach was taken was reported in one community where the SFDP was making rapid progress, but construction of a godown (warehouse) under the IRDP was at a standstill. It had been built by a contractor and finished two years earlier, but was still not opened because of a dispute over the standard of construction (it was too large anyway). The things organized and managed by the community were, in sharp contrast, appropriate and operating.[7]

Examples of participatory forest protection and improvement are quite striking. In contrast to the conventional method of fencing off areas and patrolling them by government personnel, which is quite a costly and inefficient method of reforestation, six of the nine wards in one panchayat (local government area) had started up their own reforestation scheme, covering a vast stretch of hillside belonging to the contiguous wards stretching over eighteen kilometers.

> The place was once full of green forest, but when the Forest Department declared all forest to be government property, the run on the trees by the local villagers denuded-the entire hillside in no time, not only turning such a vast landscape into an ungainly-looking ocher-red spectacle but also causing the villagers themselves a great deal of hardship in finding fuel and fodder supply.
>
> After a few years, in 1971 the villagers again decided to redevelop the forest, and locally employed six watchmen to prevent the trespassers while the area was allowed to regenerate itself. The watchmen were each paid Rs. 120 per month which was collected by the panchayat from the people of the affected wards. A slight change in the handling of the local contribution was effected a little later when it

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[6] Literacy figures for project and non-project farmers, respectively, were 23% and 16% (the groups had started adult literacy classes); percent of school-going children was 51 and 30, respectively; 97% of project households had improved latrines compared with 50%; per capita cereal consumption was 173 vs. 151 kilograms. Morever, 45 small farmers had been elected to village panchayats in the communities organized by the SFDP (Agricultural Projects Service Centre, 1979; FAO, 1979). Shrestha (1980, p. 93) reports that some groups even required members to undergo permanent contraception after the birth of a third child, and some members were voluntarily undergoing vasectomies before that time.

> was found out that the money collected for the purpose did not always get to the watchmen. The function was therefore decentralized still further to the ward members who supervised the collection of the contribution from local households and paid the watchmen in the wards directly.

Various changes and innovations were subsequently made in the payment scheme to make it more efficient and less burdensome.

> Whatever the arrangement for the payment of salary of the watchmen, the forest continues to be protected and it is growing luxuriantly. The watchmen do continue to be interested because they think that it is their own forest. In addition, their efforts are massively supplemented by those of the individual households themselves who, because of their emotional and material involvement in the maintenance of the forest, do not stand for anybody trespassing on it.
>
> In one of its meetings last year, the village assembly reaffirmed its continued interest in the protection of the forest, decided to increase the number of watchmen where necessary, and resolved to request the Government to desist from putting a barbed wire fence around the forest, suspecting that such an act on the part of the Government might alienate them from their right over it.
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> This example of forest development not only demonstrates that the villages, given the opportunity, have the capability to plan and implement their own development programmes, mobilize their own resources and manage the project on a continuing basis, but also that the areas of developmental intervention by the Government have to be judiciously identified so that they do not bring about any negative effects on the local initiative. (Shrestha, 1980, pp. 89-90).

This interest and capacity to initiate and manage forest activities is not unique to this one community. In the neighboring community where small farmer groups have been organized, they got land from the government on which to start a group orchard, in return for which they are protecting the surrounding forest area, charging and enforcing a Rs. 50 fine for trespassing, with half the fine going to the panchayat and half to the informer (Shrestha, 1980, p. 92). In a nearby district, a panchayat, after observing the Forestry Department lose about 90% of the seedlings planted in a reforestation area surrounded by expensive barbed wire and watched by government guards, undertook through self-help to plant and patrol the area without the aid or cost of barbed wire and guards, achieving a survival rate of about 90%.[8]

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[7] Shrestha (1980, pp. 93-94) found the same problem of an unopened project godown in a second community he studied in the RNRDP area.

[8] This was reported to the author by a member of parliament from that area, Mr. P.S.J.B. Rana. Fifty-eight percent of the national reforestation budget goes for fencing, with limited effect (Campbell, 1979).

The work of an enterprising Forestry Officer, taking initiative to involve villagers through their panchayats in the Chautara area of Sindhupalchok and Khabre districts has attracted much attention, as 22 of the 122 panchayats in the area have undertaken forestry-reforestation programs, producing visible success within 5-6 years. Thick forest covers have been regenerated on once denuded hillsides. Communities have taken responsibility for guarding the forests, stall-feeding their livestock whenever possible. The communities with the greatest forest problems (deficits) have been the ones more ready to invest their own time and effort.

A remarkable program of building suspended bridges, some of them 300 feet long, has been accomplished in Baglung district of Nepal through local committees. Over sixty bridges have been constructed at about one-eighth the cost (and in less time) than the government-built bridges require. The "secret" has been in using local materials, techniques of construction known to villagers, delegating responsibility to local leaders, and working out an appropriate combination of government and community inputs.[9] It is clear that there is no way the government can, with its own resources and with its costly techniques and slow implementation, provide enough bridges to make much improvement in the transportation system within fifty years. The more participatory approach, on the other hand, can telescope that time and allow the government to put its financial resources to other uses.

Recently, the Agricultural Projects Service Centre (APROSC) in Nepal has completed an evaluation for the Ministry of Food, Agriculture, and Irrigation of ten small-scale irrigation projects; among its conclusions are the following:

— Local popular participation in the decision-making process helped to identify more technically viable projects. Those projects in which the local people participated in the identification and design of the project proved to be technically more successful.

— There was a positive correlation between popular participation and improved agriculture. Thus, projects in which there was genuine popular participation contributed more successfully to the development of agriculture in the project area.

Of particular relevance to the project planning process were the following conclusions:

— Projects that were designed to irrigate larger areas proved to be less suited for popular-participation than projects that were designed for small areas.

— Heavily funded projects failed. Successful popular participation projects seem to require that outside financial and administrative assistance be kept to a minimum.

— Equity was more successfully maintained, both in respect to resource contribution and to the distribution of benefits in those projects where the local people were involved in the decision-making process. This seems to suggest that popular participation has important implications for the equity aspects of national development.
(From draft summary of Agricultural Projects Service Centre, undated.)

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[9] This experience is analyzed in Pradhan (1979, pp. 29-44).

Thus, even in an environment physically quite formidable, with nearly 90% illiteracy and a controlled political system, the possibilities for broad-based and multifaceted participation rural development efforts, including agricultural improvement, are becoming more apparent. Many more examples could be given from other countries, but I would like to discuss briefly the very instructive experience with participatory improvement of irrigation in the Philippines as it relates directly to farmer involvement in efforts to improve food production.

Irrigation is critical for increases in rice production in the Philippines. In the past, development has been dualistic, with the government undertaking large-scale schemes and with communities operating smaller "communal" schemes, which ranged from hundreds to thousands of hectares. The latter roughly matched the former in total extent, The National Irrigation Administration (NIA) by the mid-1970s appreciated that improving the efficiency and extent of communal schemes was a cost-effective way to raise production, and the Ford Foundation assisted it in evolving approaches and roles for working with farmers in this task. Beginning with carefully conceived and monitored pilot projects, NIA is now rehabilitating dozens of communal schemes and expects to expand its cooperative operations further.[10]

Under this approach, farmers undertake to repay the capital costs of upgrading their scheme and to reduce these costs in the construction stage by contributing labor. Once completed, the farmers; through their Irrigation Service Associations, also manage the schemes, distributing water, collecting fees, and ensuring maintenance. By contributing labor, the cost of installing labor or stronger water diversion structures and improved channel distribution systems is reduced by about half. Marginal, but important, savings are effected through the work of Quality and Quantity Committees, which monitor the materials delivered to the building site and return inferior materials to the NIA.

At Laur, warehousemen were appointed to keep inventory and reduce losses. Of great symbolic and some financial importance, since the farmers were paying for the fuel used in construction, they were able to curtail staff use of vehicles (and fuel) for non-project travel (engineers were driving into town for lunch instead of bringing it to the site as the others did). In the Laur case, the farmers were unsuccessful in their first major disagreement with the technical staff. They objected that the wire mesh dam designed by the engineers would not be strong enough, but they were overruled with technical arguments, equations, etc. The engineers were, however, also unsuccessful, since the dam, built by the NIA and farmers together, washed out a few months after completion. This happened in a Nepal case, too, where farmers had a better idea of what was technically feasible than did project engineers. Shrestha reports on a check dam being built in the project area:

> Although this project was undertaken for the benefit of the local people they were little involved in its planning. When the time came for implementation, the local people wanted to have it built on a (stronger) foundation... (which) was not included in its design and estimate, and so the request was not complied with. Even the

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[10] This experience is discussed by Isles and Collado (1979), Bagadion and Korten (1979), Alonso (1981), Bagadion and Korten (1980), Korten (1980, pp. 492-494), and Korten (1981).

> gabion wire mesh was made by labor imported from India which local people could easily have made, or have been trained to make. As it turned out, in the last monsoon, the dam gave in at the base, thus confirming the apprehension of the villagers, who now want a new one built in its place. (Shrestha, 1980, p. 93)

Although there were many "teething troubles" in getting collaboration between NIA staff and Philippine farmers started, and it took several years to devise appropriate divisions of responsibility, establish communication mechanisms, build up mutual trust and respect, and institutionalize procedures, the effort is now launched and expanding on an efficient basis. It is not possible to go into a detailed discussion of the lessons learned from this experience, rather, in the following section, I will draw on the experiences discussed already, and also on other experience from our Rural Development Committee work on participation, to suggest directions for reorienting development efforts so that more productive participation by farmers and other rural residents can strengthen performance.

General Considerations on Development Participation

To suggest that more participatory approaches would be advantageous, as a rule, is not to dispense with the roles and responsibilities of technical and administrative personnel in project development and management. As has been argued elsewhere, the "populist" fallacy that the rural majority has sufficient knowledge, skills, and dedication to bring about development by itself is as misplaced as the "paternalist" fallacy that the bureaucracy knows and can do all that is needed to accomplish development tasks (Uphoff and Esman, 1974, pp. 3-6). In fact, both sets of actors have necessary—and neither have sufficient—capabilities. The task is to find ways that their respective sources of information, initiative, critical appraisal, organization, and effort can be linked. This is not an easy task. A recent study for the World Bank by Perret and Lethem says:

> Appraisal or implementation of recently financed, Bank projects suggests that the feasibility of local participation should not be taken for granted by project designers: interest may be low or labor may be scarce when needed for construction work; there may be no truly representative grassroots structures which can link up with those of the government; or people may not have enough information or experience to make sound investment decisions. Bank-financed projects are, in addition, larger and more sensitive to time than the small-scale, often informal, activities upon which prior experience was gained and on which project design is predicated. (Perret and Lethem, 1980, p. 6)

The process of involving people in the planning process itself takes some time:

> Participatory programming, in particular the discussion of investment proposals with both local communities and technical agencies, may cause a certain lengthening of the planning process and has usually to accommodate a number of divergent views. There is, however, a trade-off, in the sense that participatory programming, as opposed to ‘ivory tower’ programming, has a better chance to avoid the adoption of inadequate solutions (or of solutions not desired by the local communities) and may also speed up the

> subsequent implementation process considerably. When scheduling participatory programming, an appropriate time horizon should be provided to allow for this necessary lengthening of the planning process. (Cernea, 1979, p. 123)

It is clear that greater participation will not come about without some deliberate and sophisticated, as well as genuine, efforts on the part of those having responsibility for project formulation, design, and operation. The purpose must clearly be that those who are expected to participate more fully will indeed benefit from this participation and from the project. Too often, what provisions are made for participation are intended principally to assist the government, to collect loans, to plant certain crops desired for their export earnings, and to carry out sectoral plans formulated in the capital, whether or not these things were of interest to farmers. Their interests are not the only ones to be considered, but participation can only be justified and sustained on the basis of mutuality and brokering of their, and the project's, aims.[11]

The reasons why project planners and managers have (or should have) an interest in greater participation are several, and they are related to each other. They include the following: (a) optimum resource allocation, (b) improved technical design, (c) resource mobilization, (d) maintenance of facilities and services, and (e) political benefits to government. We recognize that there are factors at the local level, as well as within the bureaucracy, that restrict attainment of these values. For example, there may be lack of understanding of technical possibilities or financial constraints within the community, social divisions that may make consensus difficult to achieve, or a local power structure that biases benefits. Yet, in most circumstances, with appropriate design efforts, these can be ameliorated.

Optimal resource allocation. In a resource-constrained situation, it is important to allocate resources to their most productive and appropriate use. This means meeting priority needs and tailoring efforts to specific conditions. Given the variability of local circumstances throughout LDCs, people's input to decision-making and design in LDCs is all the more important. Economists and administrators like to point to the efficiencies gained from standardization of efforts. But there can also be diseconomies-of-scale. An example of this is reported in Nepal where standard-length bridge units. had to be installed upstream or downstream from where the trail crossed the chasm, where they would have been most efficient.[12] Economies-of-scale are often outweighed by economics of detail.[13] There is little evidence to suggest that the differences in time for tailoring activities to needs and situations are significant compared with the conventional, top-down methods of planning and implementation, which are fraught with their own delays. Significantly, such tailoring not only economizes on resources, but contributes to resource mobilization, maintenance, and political support.

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[11] This issue has been addressed somewhat differently, but usefully, by Perrett and Lethem (1980) in terms of "planning for use" rather than just "planning for access." It should be appreciated that the latter represents an improvement upon the conventional planning simply for outputs, without worrying about who will have access to them. Advancing analysis to promote use rather than just to provide access is a third-order problem only now coming to be appreciated.

[12] Examples given by Pradhan (1979, pp. 30-31).

Improved technical design. At least with appropriate consultation, some mistakes can be avoided in designing project components, as Cernea has suggested above. There are many examples of ways in which planners and technicians have made wrong assumptions about what technology would work, what the level of demand would be, what resource mobilization would occur, etc.[14] But the advantages of participation can also be found in "harder" technical terms. We have seen how farmers could have contributed to better design of the irrigation system and dam construction in Nepal and the Philippines, and we have APROSC's conclusion based on comparative analysis of small-scale irrigation schemes: "Those projects in which the local people participated in the identification and design of the project proved to be technically more successful." This does not mean they could design large-scale schemes or that no "expert" inputs are needed in smaller schemes, but it does suggest that even in large schemes, more participation in planning "downstream" development would be appropriate.[15] There is more technical capacity to be drawn on from local people (even if not expressed in highly educated terms) than engineers, technicians, planners, and managers commonly recognize.

Resource mobilization. The resources of money and labor, as well as local materials, which many projects have mobilized by working in a participatory mode, are impressive, but there remains still more potential if administrators and technical staff are willing to work more cooperatively with local communities. To the extent there is such mobilization, the resources of the central government can be spread further, and it has been found that maintenance follows more readily because the facility or service is viewed by the community more as "theirs" than if financed entirely by the government.

Maintenance. Because participatory approaches have been the exception rather than the rule, there is not much systematic evidence on this as one would like; but what evidence there is points in this direction. A World Bank study of rural water supply systems found that these were better maintained, less abused, and had a higher level of financial performance to the extent there was village participation in decisions about installing the systems, plus contribution to construction costs and payment of water fees once the systems were in operation (IBRD, 1976, p. 63; Miller, 1979). This finding is supported for other sectors by various reports.[16] Of course, the kind of technology involved will affect the ability of local people to handle maintenance by themselves. Thus, their involvement in technical design, as well as construction,

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[13] Clement Onyemelukwe (1974) calls these "economies of de-scale."

[14] Examples from World Bank projects are cited in Perrett and Lethem (1980) stressing the need to understand local preferences in choice of technology and human factors in spatial planning and architectural design.

[15] Dismaying examples of large-scale irrigation development in Ghana lacking any participatory substance are analyzed by Chambas (1980, pp. 145-167). The Vea and Tono projects could hardly have failed to be improved by almost any kind of participation, and some of the ways in which they squandered resources can be attributed to the lack of farmer participation in planning.

[16] At a workshop held at the World Bank in September, 1979, in preparation for a WDR 1980 paper, one staff member with experience in Calcutta urban development reported on the improved maintenance (and willingness to pay taxes for upkeep) after a decentralized, participatory approach to local planning was introduced in planning that city's rehabilitation.

influences their capacity as well as willingness to do maintenance.

Political benefits. While donor agencies may not be particularly concerned with this consideration, LDC governments must be. They are often ambivalent or even indisposed toward much participation from below. Yet, to the extent this produces more successful projects and distributes benefits more broadly (also minimizing undesirable side-effects), this should boost the political credit accruing to the regime.[17] We have noted above the more equitable distribution of benefits associated with more participatory irrigation development in Nepal, studied by APROSC. Not all regimes will seek greater equity, but there are, nevertheless, some benefits to be obtained.

* * * * *

Experience with participatory approaches to agricultural and rural development are accumulating, and our knowledge of how to follow such avenues is growing, though it also tells us that participation to be fruitful must be relevant to the task, the environment, and, most of all, to the people concerned. Because of the increasing concern with participation, it is possible to make more specific suggestions of how to follow this approach, but application will always remain to be done in particular contexts.[18]

One of the interesting things about pursuing a participatory approach to development is that it cannot be done mechanistically or routinely. Rather, it can only be done with the active "participation" of planners, technicians, and administrators themselves as they seek to create opportunities and incentives for intended beneficiaries (no longer considered as "target groups").

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[17] Such considerations are analyzed and assessed by Norman Uphoff (1980). Circumstances inducing political costs are also discussed.

[18] Section VII of the longer paper from which this was prepared goes into more specific implications of this analysis and approach (World Bank, 1981). A fairly detailed discussion of operational possibilities is presented in a paper prepared for U.S. AID, Providing for More Participation in Project Planning and Implementation. That paper summarizes conclusions about "rural development participation" derived from a cooperative agreement between the Rural Development Committee of Cornell University and the Office of Rural Development in U.S. AID. It will be available from the RDC or U.S. AID (ST/RAD).

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BRIDGING THE GAP BETWEEN FARMERS AND RESEARCH

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Most any phenomenon can be regarded as a whole or partial system, and perhaps for this reason research on agricultural systems has accommodated a wide range of popular ideas and initiatives. While the ideas emphasized in the cropping systems programs at the International Rice Research Institute (IRRI) provide useful new directions in agricultural research, they are among many possible features of a system approach. The objective of the program is to increase food production by finding ways to grow more crops per year on ricelands—either additional rice crops, or other crops with rice. Distinguishable features of the program are that (a) research is conducted jointly among disciplines; (b) cropping intensity is emphasized over yield per crop; and (c) experiments are conducted on sample farms rather than at experiment stations.

The third feature—on-farm research—is a way of bridging the gap between farmers and researchers and is the subject of this paper. Reasons for conducting research on farms, what it achieves, and the problems that arise will be reviewed after a few comments about the first two aspects of IRRI's cropping systems research that help to put the last in context.

Joint Research Among Disciplines

The technical problem of increasing the number of crops grown on ricelands each year requires a knowledge of crop production and farm and village affairs derived from several disciplines of agricultural research. Hence, the nature of the problem indicates some of the structure and procedures of the effort needed to solve it. Scientists representing several disciplines—two in 1970 and more since 1975—are employed expressly to cooperate in cropping systems research, while nominally attached to respective IRRI departments.

It is also clear that solutions, new cropping patterns in this case, are suited to relatively small geographic areas and that many area-specific research projects are required. Therefore, technicians from widely dispersed projects in Southeast Asia are trained in methods that include procedures for site selection, site description, cropping pattern design, cropping pattern testing, introduction of new technology, and evaluation of results.

Cropping pattern testing is the heart of research and displays principle attributes of the program. In a cropping systems experiment, a specific arrangement of crops in time and space is hypothesized to fit certain physical and economic conditions found at a research site, usually an area of several adjoining villages. A pattern "fits" if it produces more food and farmers accept it. Since farmers' acceptance cannot be measured directly at the time

of experimentation, the profitability of the pattern, compared to the farmers' present technology, is taken as the test criterion. The factors included in an experimental treatment are those (a) that denote the position of crops in an arrangement of crops in time and space, or (b) whose effect on crop growth are interrelated with crop position. The latter often represent different fields of agricultural research and are themselves interrelated.

Figure 1 shows an example of cropping patterns designed for a location, and Table 1 shows a comparison of alternate experimental and farmer's cropping patterns. Tables 2, 3, and 4 show results of experiments in which the factors considered are crop arrangement and prospectively related technical inputs.

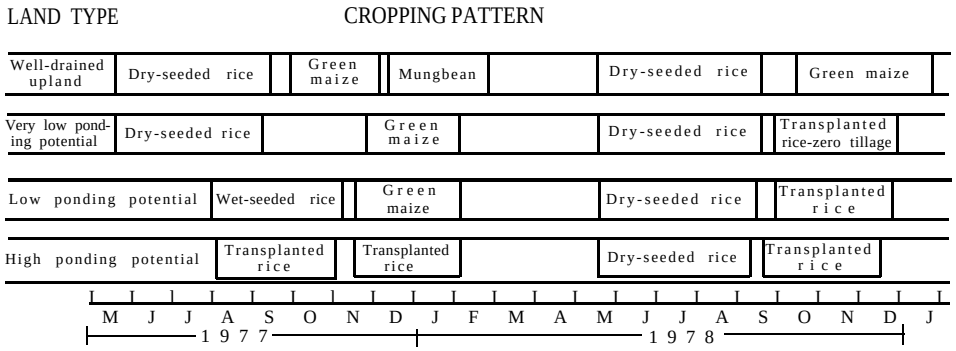
Hence, in Swanson's taxonomy of research relationships among disciplines, systems research at IRRI is "interdisciplinary" (Swanson, 1979); there is a cropping systems research methodology distinctive of that followed within the cooperating disciplines (namely economics, entomology, plant pathology, plant breeding, meteorology, engineering, extension, and weed, plant, and soil sciences). Principle objectives, hypotheses, and experiments are shared. While the composition and application of experimental treatments require the knowledge and tools of several disciplines, the outcome is assessed by common test criteria.

A cropping pattern trial is an agricultural "systems" experiment in the sense that the commonly accepted measure of outcome is the effect of several interdependent factors nominally associated with various disciplines of agricultural science. A hypothesis regarding how cropping intensity might be increased underlies the experiment, therefore, it is a "cropping" systems experiment. It is more than putting together and applying information from a range of unidisciplinary research, for previously unexamined or unexploited relationships of crops, technology, and environment are investigated.

Cropping Intensity Versus Yield Per Crop

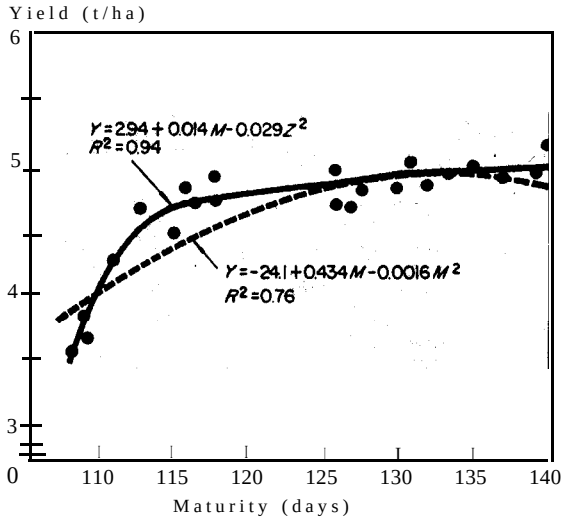
Emphasizing cropping intensity by research on crop rearrangement and addition is not to disregard yield. There is normally a trade-off between yield per crop and the number of crops per year. Particularly, to increase the number of crops in time sequence (compared to spatial multiplications such as intercropping) shorter duration varieties are used, and these are frequently lower yielding (Figure 2). Also, yield is sacrificed by placing crops in less favorable growing conditions in order to lengthen the growing season. While good management of single crops suggests choosing ideal growing periods, multiple-cropping is a study of the suboptimum—of exposing crops to higher probabilities of flood, drought, disease, and insect damage—in order to enter more crops per year. A notion of yield is essential for knowing when economic losses from yield per crop are just balanced by gains from cropping intensity. High-yield technology is a "given" to the research problem and often the key to maintaining the profitability of crops under stress conditions and, hence, to increasing the cropping intensity.

In addition to interdisciplinary, multiple-cropping, on-farm research, some less central ideas associated with the IRRI cropping systems program require mentioning. Whole-farm analysis, integrated pest management, multi-location testing, and certain approaches to land and weather classification are promoted mainly within the cooperating disciplines. More importantly, the research is conducted mainly in, and for, rainfed, lowland rice areas—places where solely current rainfall is impounded on rice fields. These are to be distinguished from riceland—where irrigation facilities augment current



Cropping patterns used in fields having different ponding potentials. IRRI, 1977-78.

Figure 1. (Source: IRRI Annual Report for 1979)



Mean grain yield vs maturity of 22 selected entries from the fifth international rice yield nurseries (IRYN-E, IRYN-M). IR36, currently used extensively in cropping systems research at IRRI, had a mean maturity of 118 days and yield of 4.8 t/ha in the yield nursery.

Figure 2. (Source: IRRI Annual Report for 1978)

Number of experimental (E) and farmers' (F) plots analyzed by crop year (CY) and cropping pattern Iloilo and Pangasinan, Philippines, 1975-78.

Cropping pattern	Plots (no.) analyzed					
	CY 1975-76		CY 1976-77		CY 1977-78	
	E	F	E	F	E	F
			Iloilo			
Rice	10	28	8	20	13	68
Rice-upland crop	47	36	14	30	47	32
Rice-rice	13	11	22	78	34	98
Rice-rice-upland crop	13		50	10	2	10
Upland crop-rice-upland crop	6					
Rice-rice-rice			16	7	7	
Total	89	74	110	145	103	208
			Pangasinan			
Rice				13		29
Rice-uplandcrop				103	32	152
Rice-rice	78	54	31	22	22	11
Rice-rice-upland crop	3		10	2	18	3
Upland crop-rice-upland crop	18		23	12	15	7
Rice-rice-rice			6			
Total	97	54	80	152	89	204

Table la. (Source: IRRI Annual Report for 1978)

Additional investment in total variable costs and rates of return on additional investment for replacing farmers' present pattern with a different farmers' pattern or an experimental cropping pattern. IRRI, 1978.

Land type	Farmers' cropping pattern to be replaced	Rate of return on TVC[a]	Replacement pattern[b]	Increase in TVC (%)	Incremental rate of return[c]
Shallow water table, irrigated	Rice-fallow	1.7	Rice-mung bean (F)	40	1.6
			Rice-rice (F)	120	2.1
			Rice-rice (E)	370	1.4
			Rice-rice-upland crop (E)	430	1.4
	Rice-mung bean	1.6	Rice-rice (F)	160	2.3
			Rice-rice (E)	240	1.4
			Rice-rice-upland crop (E)	280	1.4
	Rice-rice	1.9	Rice-rice (E)	120	1.1
			Rice-rice-upland crop (E)	150	1.2
Shallow water table, rainfed	Rice-mungbean	1.7	Rice-mung (E)	70	1.4
			Rice-rice (E)	80	0.5
			Rice-rice-upland crop (E)	120	1.2
Deep water table, irrigated	Rice-fallow	2.3	Rice-mung (F)	90	2.2
			Rice-rice (E)	300	1.2
			Corn-rice-upland crop (E)	410	1.8
	Rice-mung bean	2.3	Rice-rice (E)	110	0.7
			Corn-rice-upland crop (E)	170	1.7
Deep water table, rainfed	Rice-mung bean	1.9	Rice-mung bean (E)	140	1.5
			Rica-rice (E)	220	1.3
			Rice-rice-upland crop (E)	260	1.6

[a]TVC = total variable costs (labor and materials). [b]F = farmers' management, E = Improved management, as in experimental trials. [c]Indicates the number of dollars returned per dollar spent on additional variable inputs required in switching to new pattern.

Table 1b. (Source: IRRI Annual Report for 1978)

Effects of planting date and rate of nitrogenous fertilizer on grain yield of IR36. Iloilo, Philippines, crop year 1978.

Nitrogen level (kg N/ha)	Grain yield[a] (t/ha) when crop was planted on							
	1 Sep	15 Sep	2 Oct	14 Oct	18 Oct	4 Nov	12 Nov	30 Nov
0	3.7 c	2.7 b	3.4 b	4.0 c	3.2 c	3.4 b	2.6 a	0 a
30	4.1 bc	3.1 ab	4.1 a	4.7 b	4.3 b	4.1 a	2.5 a	0 a
60	4.3 ab	3.3 ab	4.1 a	5.4 a	4.4 b	4.3 a	2.5 a	0 a
90	4.9 a	3.7 a	4.5 a	5.8 a	5.1 a	4.3 a	2.5 a	0 a
								CV=13%

[a]Separation of means by LSD, 5% level.

Table 2. (Source: IRRI Annual Report for 1979)

Effect of rice stubble management and tillage systems on preflowering insect pests of cowpea established after flooded rice." IRRI 1978.

Rice stubble	Tillage	Insects[b] (no./15 plants)			Yield (kg/ha)	
		Bean fly larvae + pupae 13 DE	Thrips 20 DE	*Empoasca* 20 DE	With preflowering insecticide[c]	Without preflowering insecticide
None	Plowed and harrowed twice	17 a	83 a	36 b	687 bc	316 e
Mulch 2 cm high	Plowed and harrowed twice	15 a	8 b	13 c	571 cd	354 e
	Furrows plowed between rice rows	15 a	82 a	83 a	480 d	532 d
2 cm high	Dibbling in rows	12 b	9 b	53 ab	775 b	575 cd
15 cm high	Furrows plowed between rice rows	9 bc	6 b	13 c	815 b	621 c
15 cm high	Dibbling in rows	8 bc	15 b	9 cd	944 a	799 b
30 cm high	Furrows plowed between rice rows	6 c	1 b	6 cd	626 c	360 e
30 cm high	Dibbling in rows	5 c	1 b	2 d	964 a	525 d

"Av of 3 replications. IR36 was transplanted at 25 x 25 cm. Means followed by a common letter are not significantly different et the 5% level. [b]Without insecticide. DE = days after emergence. [c]1% wt/wt carbofuran seed treatment, 0.5 kg active ingredient monocrotophos/ha and 1.0 kg a.i. carbaryl/ha sprays. All plots received a similar portflowering protection of 1.0 kg a.i. monocrotophos/ha spray.

Table 3a. (Source: IRRI Annual Report for 1978)

Effect of intercropping on the severity of Cercospora leaf spot and on grain yield of mungbean. IRRI, 1979.

Treatment[a]	Disease severity[b]			Yield (t/ha)
	33 DE	47 DE	61 DE	
Sole mungbean				
Treated	1.4	1.7	6.4	1.2
Untreated	1.5	3.7	_c	0.7
Mungbean + maize in 1.5-m row				
Treated	1.4	1.4	5.8	0.7
Untreated	1.6	4.0	_c	0.3
Mungbean + maize in 3.0-m row				
Treated	1.5	1.8	6.7	1.2
Untreated	1.6	3.8	_c	0.5

[a]Treated plants received 2 sprays of benomyl (0.30 g/liter water per spraying) at 29 and 43 days after emergence (DE). [b]On a leaf basis. using 4 lower leaver/plant, 6 plants sampled/plot. Each leaf was rated on a scale of 0 to 9: 0 = no infection, 1 = 1-5% leaf area infected, 3 = 6 to 25%, 5 = 26 to 50%, 7 = 51 to 75%. and 9 = 76 to 100%. [c]Complete defoliation.

Table 3b. (Source: IRRI Annual Report for 1979)

Yield of dryland rice as effected by time of land preparation and weed control method.[a] IRRI, 1979 wet season.

Treatment[a]	Herbicide rate[b] (kg a.i./ha)	Yield[c] (t/ha) from land prepared in		
		Mar	Apr	May
Weeded twice, 2 and 5 WE	—	2.1 a	2.1 a	0.5 a
Weeded, 3 WE	—	1.3 b	0.7 b	0.3 ab
Propanil -- fenoprop, 2- to 3-LSG	3	0.7 c	0.6 bc	0.3 ab
Propanil, 2- to 3-LSG	2	0.3 de	0.5 bcd	0.1 b
Flurodifen PE	2	0.4 cd	0.2 de	0.0 b
Butachlor PE	2	0.2 de	0.3 cde	0.0 b
2,4-D, 2- to 3-LSG	1	0.2 de	0.0 e	0.0 b
No weeding	—	0.0 e	0.0 e	0.0 b

[a]WE = weeks after crop emergence, LSG = leaf stage on the grassy weeds, PE = preemergence. A dash (—) between herbicides indicates that they were formulated as a proprietary mixture. [b]a.i. = active ingredient. [c]Av of 3 replications. In a column, means followed by a common letter are not significantly different from each other at the 5% level.

Table 4a. (Source: IRRI Annual Report for 1979)

Effect of different cropping patterns on the weight of weeds growing in association with the first crop in the rotation in 1978.[a] IRRI 1978 wet season.

Cropping pattern			Weed wt (g/m^2), 5 wk after crop emergence							
First crop	Second crop	Third crop	*Amaranthus spinosus*	*Ipomoea triloba*	*Rottboellia exaltata*	*Cyperus rotundus*	*Eleusine indica*	*Echinochloa colona*	Others[b]	Total
Rice	Maize	—	217.2 bc	14.8 ab	24.8 ab	0 b	0.4 bc	41.2 a	32.0	521.6 a
Maize	Rice	Mungbean	651.2 a	6.4 ab	179.2 ab	0.8 ab	3.2 ab	1.2 ab	8.0	850.0 a
Mungbean	Rice	Mungbean	253.6 ab	2.0 ab	49.6 b	1.6 ab	2.8 abc	0 b	28.4	338.0 a
Rice	Sorghum	—	91.6 bc	17.2 ab	639.6 a	0 b	0 c	16.0 ab	2.4	766.8 a
Maize	Maize	Maize	296.4 abc	3.2 ab	96.4 ab	0.8 ab	5.6 a	0.8 ab	52.8	456.0 a
Mungbean	Mungbean	Mungbean	373.6 ab	38.4 a	91.6 ab	2.8 ab	0 c	11.6 ab	16.0	534.0 a
Sorghum	Sorghum	Sorghum	532.4 a	0 b	15.2 b	4.8 a	0.4 bc	10.8 ab	0	603.6 a

[a]In a column, means followed by a common letter are not significantly different at the 5% level. [b]*Trianthema portulacastrum and Digitaria sp.*

Table 4b. (Source: IRRI Annual Report for 1979)

rainwater supplies—and from "upland rice" areas-where water is not impounded. Irrigated areas are already intensively cropped in rice, as appears to be their and new multiple-cropping research would contribute little, unless irrigation costs eventually make diversification into dryland crops of intrest. Tall, photosensitive, long-duration, traditional rice varieties persist in upland areas and their traits will give little opportunity for Improving cropping patterns until superior rice varieties are developed and introduced.

The Farmer-Scientist Linkage and On-Farm Research

A two-way flow of information is needed between farmers and agricultural researchers. Scientists need to know what kind of technology farmers require, and farmers need to know what new technology science has wrought. Agricultural extension workers have normally been charged with the task of delivering new technology from the research establishment to farmers, and, to a lesser extent, have served to inform scientists about technical problems facing farmers (Stevens, 1977). However, scientists in developing countries are showing an increasing interest in understanding the farmers' situation first-hand by conducting on-farm trials (Stevens, 1977). Reasons for this and some of the experience and results of IRRI's on-farm research will be reviewed in detail below. Questions about the possible efficacy of scientists' engagement in technology delivery will be discussed first.

Research and Technology Delivery

After several decades of attention to problems of agricultural development, there is still general concern that technology is not being effectively delivered to farmers. The extension service in many countries is sufficiently small, or limited in training, mobility, and other manner of support, that it must be concentrated in places and on problems of greatest urgency (Norman, 1977). The present emphasis on "technology packages" and special programs for their introduction reflects, in part, a strategy of directing extension personnel toward specific problem areas and preparing them better than would be possible over a broader range of subject matter (Win, Nyi, and Price, 1981). While continued improvement of extension services is needed, it is increasingly clear that researchers of prospective technical advances in agriculture should take greater responsibility for their introduction.

On reviewing two decades of failed efforts to modernize agriculture in developing countries, T.W. Schultz suggested that the "natural order" of things to be done was to find "high pay-off inputs" through new research, assure that local industry is in a position to manufacture and supply the inputs, and provide information to farmers regarding the new technology. But, the mistake of attempting the last before the first two steps were taken was made repeated. Where farmers in poor countries do not respond to agricultural assistance, it is likely that "no really profitable or rewarding new agricultural inputs have been developed and produced and supplied to farmers cheaply enough to make it worth their while" (Schultz, 1964). Another two decades later, sophisticated research institutions are now in place in poor countries and offer a range of modern inputs proven to yield well on local experiment stations. Despite much success, a gap persists between the technology that farmers employ and that recommended based on research. Has extension ineffectively presented the new technology to farmers, or are the inputs insufficiently rewarding to farmers to be of interest?

At IRRI's 1981 annual review of research results and future plans, no issue was of greater interest to scientists than the question of whether research or extension had failed to deliver technology to farmers. The international agricultural, research institutes have generally relied on national agencies and programs to disseminate technology from the institutes to farmers. But, on the evidence of shortfalls in farmer adoption of new technology, that link—the flow of (information from researchers to extension workers to farmers—now appears weak. There are several possible reasons that farmers have adopted less of the new technology than scientists might expect. Analysis of constraints to higher rice yields show that much of the observed difference between farmer's and experiment station technology and yield can be explained either by differences in physical environment, such as water control and soil properties, or by farmer's rational economic behavior (Herdt and Wickham, 1975). To an extent, Schultzs' characterization of certain attempted introductions still applies—they are not sufficiently profitable to farmers. However, weaknesses in the flow of demonstrably profitable technology to farmers remains, and its principle aspects are discussed below.

Small extension agencies and unattractive technology notwithstanding, the adoption of high pay-off inputs is delayed by their disjoint invention, production, and supply to farmers. Inadequate conceptual and operational models of the research-to-farmer linkage (particularly models that might apply between internationally-funded research and farmers in poor countries) are largely to blame. There is a gap in the theory and empirical tests of alternate models—a gap which researchers must work as quickly as possible to fill.

The Integrated Agricultural Production and Marketing Project recently completed in the Philippines by Kansas State University is a major step in this direction. It and similar programs by national and international agencies should be critically reviewed, and detailed models formulated of the process by which technology might best reach farmers.

Lessons drawn from the experience of cropping systems research at IRRI also indicate more specific responsibilities of researchers toward improving the researcher-to-farmer flow of information, First, because of their familiarity with the characteristics of the technology they invent, researchers should specify the features of infrastructure that will be necessary to support new technology upon its introduction to farmers. The timing and amount of credit demands, new irrigation requirements, or periods of high labor or traction power demand that governments might seek to alleviate can be indicated. Possible conflicts with tenurial arrangements of new cropping patterns and the need for new marketing and processing facilities might be approached before the technology is introduced.

From 1975 to 1977, the cropping systems program conducted its own small extension project to gain insight on problems faced when new technology is introduced and how these might affect the research that should be done—the project introduced grain sorghum after rice in Batangas Province, Philippines. The technology that looked highly promising in trials on farmers' fields eventually succumbed because private entrepreneurs would not make the high investment required for new infrastructure—marketing and processing facilities for the new crop, primarily threshing machinery (Nicholas, Galang, Garrity, Huelgas, Garcia, and Price, 1976).

Second, researchers must report their results in a manner that facilitates their interpretation and application to field problems. International agricultural researchers attempt to satisfy several quite diverse user groups in the reporting of their research. Colleagues in different disciplines collaborating on the same problem area require different information from that expected by disciplinary colleagues within and without the research institution. Scientists in national agencies are important clients of international agricultural research and their requirements for information are different from those of institutional colleagues; all of these interests may diverge from those expressed by international funding agencies. There can be little surprise that the need of extension agencies for information that can be conveniently interpreted and applied to farmers' problems is often the last consideration of the researcher. Research results are not well articulated to the extension institutions of developing countries. Distilling into a practical format, the information available from international agricultural research would itself comprise a formidable research effort. It is incumbent upon the inventors of new technology to learn the institutional and farm level conditions in which research results will be applied, and to facilitate their application through understandable and correctly qualified reporting.

Third, researchers, particularly research administrators, should seek institutional arrangements according to which extension workers participate in research sufficiently to understand the special resource requirements and sensitivities, advantages, and disadvantages of new technology. New crop sequences and their management are particularly sensitive to seasonal and locational gradients in environment. Participation in the research trials, leading to the recommendation of new technology for a location, can valuably augment extension workers' understanding of the techniques they are to introduce to farmers.

This linkage between research and extension is made in IRRI's cropping systems research by including national government technicians as regular members of the field research staff. At the end of research, when technology is introduced to farmers, the former research office and other facilities are transferred fully to the national agencies for demonstration and maintenance research purposes. Maintenance research is sometimes necessary to investigate new problems that arise after new cropping patterns are introduced, for example, new and different pests, or the release of new crop varieties that might substitute for those introduced earlier.

Finally, an incidental feature of on-farm research is that farmers see—indeed participate in—experimental trials in their villages, and may adopt techniques before "extension" takes place. While such cases of adoption are satisfying to researchers and may short-cut the testing of new technology for its potential acceptability by farmers, formalization of this direct flow of information from researcher to farmer has been avoided. The International Rice Research Institute's cropping systems research program, and that of the national research programs with which it cooperates, does not include direct extension of new technology to farmers. The methodology stage of "technology introduction" refers to the articulation of scientific information to extension institutions, and supporting extension with research on, and specification of, infrastructural requirements—the first item above.

In summary, to some extent, the unprofitability of technology and incapacity of extension institutions may account for some lag in the adoption of new agricultural technology in developing countries. But, an important general role for scientists in bridging the gap between research and the farm

is in formulating more adequate models of the conceptual and operational linkages from researchers, to extension, to farmer. More specific tasks of researchers in promoting the flow of information to farmers are (a) to conduct research on, and specify the infrastructural requirements of, new technology; (b) to report research results in a manner that facilitates extension; (c) to establish institutional links that encourage participation of extension workers in research, thereby enhancing their understanding of new technology; and (d) to distinguish the information gathering role of on-farm research from incidental extension effects and avoid formalization of the latter.

On-Farm, Research

Hayami and Ruttan (1971, p. 57) suggest that shifts in relative prices of agricultural products and resources induce farmers to "press the public research institutions to develop the new technology" that saves increasingly scarce. factors of production. "Perceptive scientists and science administrators respond by making available new technical possibilities and new inputs." Agricultural researchers recognize the need to understand and respond to farmers' technical problems, but in a market economy, it is not really necessary for them to actively cultivate the flow of information from farmers. Political pressure and influence by farmers will bring about the needed research and eventual technological changes. Indeed, this has been the case at U.S. land-grant institutions (Hayami and Ruttan, 1971).

Why have scientists in international agricultural research (particularly on agricultural systems, and including cropping systems work at IRRI), stressed the need for research on farmers' fields? Stevens (1977, p. 249) comments that research on farmers' fields "is being accepted by professionals as necessary before conclusions can be made that new technology will be productive on small farms. Hence, government policies and programs are required that develop a national professional capability to carry out tests of new technology on farmers' fields." In IRRI's research, they are not simply tests of technology previously developed on experiment stations, but the original and basic research on new technology that is conducted on farmer's fields.

"Experience suggests," according to Nelson, "that better technologies are possible and need to be specifically developed and tested on site." This is because "soil type, temperature, rainfall conditions, the insect and pest population, etc., tend to be unique to the country and the sub-area in question; hence, seeds, fertilizers, and practices that go well in one place (particularly the developed countries), may be ill-adapted to another" (Nicholas, Galang, Garrity, Huelgas, Garcia, and Price, 1976, p. 73). Can't suitable research be conducted at experiment stations, or sub-stations, or simply on rented tracts of land where better controls might be exercised than on farmers' fields?

"To develop agricultural technology suited to small-farm conditions requires detailed knowledge of the quantities and qualities of the resources available to the small farmers in the different areas of a nation," including, says Stevens (1977, p. 248) "the labor supply, particularly in the periods of peak demand and slack periods; the quality of the land resources (including rainfall patterns and irrigation water supplies), current capital, and technology in use, plus any major institutional constraints that could affect the use of new technology." Agreed, much of this is said in the methods of cropping systems research (Zandstra, Price, Litsinger, and Morris). In addition to the physical aspects of the environment, detailed features of labor, traction power, credit, and other market inputs may critically affect the acceptability of new technology, nearly suggesting that technology can be preconditioned to these if it is

developed on-farm "with the farmer carrying out the operation." However, even the details of seasonal labor demand and supply, credit availability, and local problems of soil and technology compatibility should be reflected in relative prices and bring about a research response to farmers' conditions.

At present, the role of on-farm research in providing information to agricultural scientists is conceptually imprecise; the reasons it is necessary, how it is done, and what is learned have not been clearly explained. The following discussion will, as well, fall short of all the answers, but may provide additional insight to the issues.

Why on-farm research? Why form a direct link between farmers and researchers in international agricultural research? First, perhaps markets do not operate to guide researchers precisely enough. Economic and political signals may be weak between small farmers in poor countries and funders of international agricultural research. On-farm research may be viewed as an induced institutional innovation to simulate farmers' signals. Scientists sense the technological needs of farmers by producing crops under their constraints or, slightly more removed, by eliciting farmers' views of technology, resources, and other conditions. Researchers have, in fact, given considerable attention to methods of gathering and using farmer information (Chapman, 1980). According to this view of the farmer-research linkage, a premium is placed on their direct communication and on researchers' empathy with farmers.

A second possibility is that the linkage is strong and funders of international agricultural research have responded to market and political signals to a fairly disaggregative problem-level. The difference from U.S. agriculture, though—where experiment sub-stations might be established—is that the size of areas requiring separate technologies, and the potential agricultural production therefrom, may be relatively small in developing countries. Research funds are not sufficient, or the potential payoff not high enough, to place research stations in each environmental sub-region. On-farm research operates at a scale below that of research stations and sub-stations, but perhaps at the optimum scale for conditions. In this view, the point of on-farm research may simply be its efficiency—the costs versus expected gains from the kind of research conducted; the direct and explicit flow of information from farmers to scientists is incidental with respect to research policy, and research is guided primarily by the relative prices that local farmers face.

Is there reason to believe that aspects of the environment affecting the suitability of technology are more variable in developing countries than in developed ones? A case can be made for economic variability—year-round growing seasons with many choices in cropping patterns, underdeveloped infrastructure, and non-commercial aspects of production all lead to greater heterogeneity of the economic environment. It is also asserted that the physical environment in tropical regimes, particularly soil conditions and hydrology often coinciding with underdevelopment, is also more heterogeneous (Brammer, 1977; Harwood and Price, 1976). Variability in the physical environment is suppressed with the development of land infrastructure—irrigation, drainage and other forms of water control, and soil amendments.

The question of whether it is farmer information and the interaction with farmers per se that is sought through on-farm research, or whether farms are simply efficient laboratories for research, underlies much debate among cropping systems scientists at IRRI. The ambiguity remains in the methodology, for example, whether hired laborers should complete work on an experiment treatment

left by a "cooperating" farmer.

The following discussion about how to conduct research on farms generally reflects the approach of the IRRI cropping systems program, but, occasionally, the more specific view is that experiments are conducted on farms primarily because they are efficient laboratories. Research cannot be directed effectively based only upon the perceptions of scientists of what farmers say they need, or upon the responses of scientists-as-farmers operating in farmers' fields.

Structure and Operations of On-Farm Research

Research at cropping systems project sites comprises three main field activities: (a) tests of cropping patterns, (b) experiments on component technology, and (c) monitoring of environmental conditions, including current farm activities. Research on component technology is usually conducted by individual scientists and is aimed at selecting crop varieties, and preparation and seeding methods, fertilizer rates, insecticides, weed control, etc. that will then be combined in the interdisciplinary cropping pattern trials described earlier. The pattern trials are intended to determine the suitability of technology to the quality of resources available, not to the quantity of resources farmers control. Using farmers' land, labor, and implements conditions technology to local soil and water characteristics, the skills of farmers, and operating features of equipment. It does not test technology with respect to the supply conditions of labor, power, or other inputs because farmers' performance or non-performance of tasks on the 1000 M^2 plots (often watched or supervised by researchers) may not reflect usual management behavior.

Tests of cropping patterns with respect to the quantity of resources' available are accomplished by applying local market prices to all inputs and produce, including family labor. Seasonal task wages, for example, are computed as the five-week moving average of wages in cash and kind for all labor hired into 50 sample farms at the research site. For this, daily records are collected at the sample farms, including detailed information on all crop activities. The records are also used to identify present crop practices and their profitability, against which to compare the experimental technology.

A typical site covers about 2000 farms of which 15% are eventually included in research. Fifty farmers keep daily records continually over the three to five year life of a project, and on another 200 to 300 farms, experiments may be conducted—usually 60 to 100 trial plots per year. Farm land on which experiments are conducted is stratified according to characteristics that affect crop performance, and a different cropping pattern is designed for each stratum. At least seven replications of each cropping pattern experiment are attempted. All analysis and interpretation of results and eventual recommendations are done by field staff at the site.

Staff from the cooperating disciplinary departments at IRRI, usually one per department with B.S. or M.S. level training, reside at the research sites. They plan the research, and, with the help of locally hired village assistants, conduct the field experiments and surveys. Cooperating farmers select and advise on the experiments on their farms and provide the land and most labor, or keep daily records, without compensation. Volunteers are sometimes difficult to persuade when research is begun, but later there is ample willingness to participate. Local officials are consulted on scientific and management questions and are often helpful in gaining farmer support. This general approach is followed throughout the Asian Network for Cropping Systems Research. The detailed analytical procedures were formulated by representatives of the

many national programs, along with IRRI scientists (Zandstra, Price, Litsinger, and Morris).

Results of On-Farm Research

Tests of cropping patterns are conducted by comparing the profitability of experimental and farmers' patterns. The amounts of labor, materials and other inputs, and produce are recorded by village assistants on the research staff. Similar data on farmers' cropping patterns, as well as prices paid and received by farmers, are recorded daily by farmers themselves, supervised by village assistants. Scientists considering on-farm research have been concerned about the variability, sources of variability, and accuracy of information provided by farmers. Results presented below are not about the technologies tested through on-farm experiments, but about the methods used. Findings regarding the variability and accuracy of data from farms and farmers are presented. Note that the issue here is the capacity of the farm as a research facility, not the perceptions of farmers about needed technology.

Roxas, Garrity, and Price (1977) examined the relationship of farmers' estimates of labor time, field time, and yield with researchers' measurements taken with instruments. Farmers' estimates were those written in their daily records, with knowledge of researchers' checks on the data. Running field time required for major operations on each of eight crops was recorded by stopwatch. Farmers' estimates were higher than stopwatch times, but the two methods gave the same estimates of the proportion of total labor time required for each operation. Using data from all crops and operations, Roxas estimated a linear relation by regression:

farmers' estimate = 0.33 + 1.67 stopwatch estimate.

Units are in man-days, the constant term and stopwatch coefficient were significant (.95 level), and the R is .87. Roxas concluded that farmers' times are internally consistent, but higher than stopwatch time, possibly because farmers include overhead time expenditures for preparing to do fieldwork, walking to fields, and cleaning and storing implements after fieldwork (Roxas, Garrity, and Price, 1977).

Comparing cropcut and farmers' estimates of yields, Roxas concluded that cropcuts gave consistently higher yield estimates. There was a strong linear relationship between the two measurements for each of seven crops studied. For all crops combined, he estimated:

cropcut estimate = 116 + 1.02 farmers' estimate.

Units are in kg/ha; there were 58 observations; the coefficient of the farmers' estimate was significant (.95 level); and the R was .70 (Roxas, Garrity, and Price, 1977). Roxas also found that farmers slightly over-estimated land area by about 8% on average, but the error was greater on small plots than on larger ones.

Paul conducted statistical analysis of the characteristics of labor data reported by farmers in the cropping systems research project in Pangasinan Province, Philippines, 1978-79. He found that higher labor times per unit area were generally reported on smaller plots (Paul, 1980, p. 105). Some of the results of his analysis are shown in Table 5. The simple correlation coefficient between labor time reported and plot size (r) is significant for a large number of operations on various crops. Paul also concluded the following:

Table 5. Simple correlation coefficient (r) and the variability in labor data for selected crop-operation after excluding outliars. Pangasinan, 1978-79.

OPERATION	CROP[a/]	ORDER OF OPERATION	SAMPLE SIZE	MEAN	MIN.	MAX.	CV	r
Plowing	TPR	1st	86	55.0	16.5	129.5	39.5	-0.34**
		2nd	21	49.8	14.7	98.0	43.5	-0.48*
	DSWR	1st	30	50.9	16.2	88.0	39.7	-0.17^{NS}
		2nd	15	37.5	23.8	56.6	28.7	-0.31^{NS}
	Mungo	1st	60	56.1	7.0	200.0	54.8	-0.14^{NS}
Harrowing	TPR	1st	92	28.2	4.1	107.9	70.4	-0.22*
		2nd	57	24.5	9.0	111.7	68.9	-0.26*
		3rd	19	16.9	8.0	33.5	45.1	-0.45*
	DSWR	1st	31	19.5	3.5	65.0	73.9	-0.41*
Planting	TPR	—	110	134.2	31.0	349.0	42.9	-0.28*
	DSWR	—	35	20.7	2.0	35.0	42.3	0.02^{NS}
	Mungo	—	95	6.3	1.0	29.0	111.6	-0.32*
Fertilization	TPR	1st	97	10.3	1.5	74.3	124.4	0.09^{NS}
		2nd	59	6.4	1.4	18.0	52.9	-0.52**
	DSWR	1st	33	16.6	2.4	52.8	71.2	0.19^{NS}
		2nd	24	10.7	1.4	22.0	54.7	-0.24^{NS}
Insecticide application	TPR	1st	60	9.0	3.1	26.0	48.6	-0.38**
		2nd	17	8.3	2.7	12.5	36.5	-0.49*
	DSWR	1st	23	8.6	3.3	16.9	43.2	-0.10^{NS}
	Mungo	1st	82	10.0	2.4	43.5	72.0	-0.31**
		2nd	55	9.5	2.4	43.5	67.6	-0.29**
		3rd	40	8.3	2.2	24.0	50.3	-0.41**
		4th	24	13.7	2.3	43.5	66.4	-0.07**
Harvesting	TPR[b/]	—	112	251.3	48.0	919.0	59.3	0.06^{NS}
	DSWR[b/]	—	38	210.8	66.0	653.0	59.9	-0.30^{NS}
	Mungo	—	86	89.8	6.0	360.0	69.6	-0.20^{NS}

[a/] TPR: Transplanted rice; DSWR: Dry-seeded wetland rice; Mungo: Mungbean

[b/] Includes threshing. CV: Coefficient of variation; NS: Not significant at 5% level; * Significant at 5% level; ** Significant at l% level; a dash (-): Not applicable.

Source: Debi Narayan Rudra Paul, (p.8l).

1. The distribution of labor usage for different crop operations is generally non-normal with positive skewness;
2. Estimates of labor requirements for fertilization and insecticide application are likely to be dependent on the rate of fertilizer and insecticide applied, but harvest time for rice does not depend on the amount harvested (Paul, 1980).

Roxas and Paul's analyses suggest that farmers' data can provide consistent and reliable information on agricultural phenomena; that there are certain biases, but these can be identified; and that farmers' data display high variances. The nature and sources of variance are of interest as well, particularly skewness of distribution that may affect assessments of profitability. Thattil, also using Pangasinan data, showed that rice yield data are generally significantly non-normal, and the distributions become progressively more negatively skewed as labor and material input levels are increased (Thattil, 1980, p. 70). It is not obvious from the analyses, however, whether high variance and skewness of distributions are features of farmer reporting or of the phenomena observed.

Frio used farm record-keeping data from the cropping systems project in Batangas Province, Philippines to compare variability in rice yield and in multiple crop patterns, across years and across farms. Analysis of variability in crop performance is conducted with replications across space, or farms. Farmers, on the other hand, are less concerned with variability across space than with variability in outcome across time. Cropping pattern trials are tested in the same way, with replications across farms, although a fundamental aspect of multiple-cropping research is to provide some stability in the outcome across time of several crops taken together. Frio found that the variance in rice yield and also in the value of produce from multiple crop combinations was consistently lower across the four years of, observations per farm than across the 36 sample farms each year. Furthermore, the variance across time is uncorrelated with that across farms. Spatial variance cannot be taken as a good indicator of variance across time (Frio and Price, 1979).

During five years of research at Iloilo, Philippines, 46 farmers kept records of their farm activities; and, during the period, almost 1500 rice plots were planted, monitored, and reported by farmers. These data were used initially each year to analyze the comparative profitability of experimental cropping patterns; they were also used for advanced studies of factor productivities, farmer expenditure patterns, simulation analysis of cropping strategies, and various other studies, including the analyses of variability in data that has been presented above, Some of the data are summarized in Table 6 to show the variation in several aspects of economic performance, based upon data provided by farmers concerning their farms.

Means and coefficients of variation of input and output measures are similar across types of rice culture, but quite different by type of input. Variation in material input levels is much higher than for labor. Curative and preventative inputs—weeding and insecticide costs—are low expenditure items, but highly variable. Aggregates such as total variable costs and total returns have lowest variability, as might be expected. Coefficients of variation in controlled experiments at experiment stations are normally expected to be far less than 25. Research results on farmers' fields normally display much higher variability, often resulting in difficulty in showing statistically significant results. This should not be regarded as lack of rigor in conducting research, but a method better reflecting the information

Table 6. Means and coefficients of variation of economic performance data on rice reported by 46 Iloilo farmers, Philippines, 1975-1980. (Values in Pesos

Performance data per ha.	All		Local		HYV		Rainfed		Irrigated	
	Avg.	CV	Avg.	CV	Avg.	CV	Avg.	CV	Avg.	CV
No. of plots	1431		421		1010		773		658	
Labor manhours										
Land prep.	140	73	165	78	130	67	160	72	117	66
Weeding	24	271	24	286	24	265	23	295	25	244
Total	256	74	332	71	224	69	282	75	224	67
Material costs										
Fertilizer	204	162	106	150	245	152	130	138	292	148
Insecticide	35	691	30	767	36	665	27	824	44	591
Total	446	144	256	134	525	137	325	108	587	144
Variable cost	1661	55	1432	53	1756	55	1468	51	1888	55
Value product	3732	62	2582	65	4212	56	2884	66	4729	49
Net return	2072	92	1150	122	2456	80	1416	110	2841	70

upon which farmers make their decisions.

Summary and Conclusions

The three main features of cropping systems research at IRRI are: (a) joint research among disciplines, (b) emphasis on multiple-cropping rather than yield, and (c) on-farm research. A high degree of integration is achieved among the disciplines in cropping systems research by jointly designing and testing new rice-based cropping patterns on farmers' fields. Despite emphasis on increasing the number of crops grown per year, yield per crop must be considered because there is normally a trade-off between cropping intensity and yield per crop.

The gap between farmers and researchers is bridged by a two-way flow of information, often facilitated by extension institutions. Researchers are increasingly concerned about the flow of information about new technology to farmers. Major needs appear to be: (a) better conceptual and operational models of the farmer-researcher linkage, (b) specification by researchers of the infrastructural requirements of new technology so they can be better anticipated by governments, (c) reporting of scientific results in a manner that facilitates their application by extension agencies, (d) institutional arrangements by which extension workers might participate in research so as to better understand the environmental sensitivities of technology which is so critical in cropping systems research, and (e) clear distinction in on-farm research of its essential research role from its incidental extension effect.

The role of on-farm research in the flow of information from farmers to researchers is not clearly understood. It is of little importance that researchers might directly perceive farmers problems and, on this basis, choose directions for basic agricultural research. This route of understanding may be faulty; in any case, research is efficiently directed to technological needs through market and political mechanisms. On-farm research is simply an efficient facility for cropping systems research. The high degree of environmental variability in developing countries, especially tropical ones, indicates the need for separate technologies over relatively small areas. On-farm research is viewed as the appropriate scale of research under these conditions.

On-farm research is carried out by IRRI in the Philippines at sites comprising three to five adjoining villages, the farmer-residents of which participate in research. Some farmers keep daily records of their farm activities and others provide their land, labor, and implements for cropping pattern trials. Tests of cropping patterns are conducted by comparing the profitability of trial patterns with farmers own cropping patterns. Farmers volunteer for the research, they consult on experimental designs and results, and are uncompensated for their contribution.

Data from on-farm research displays higher variability than that from controlled experiments at research stations. Biases in farmer-reported data can be identified and adjustments made if desired. Sources of variability and measures that are prone to high variation can be identified. Time series variation in crop performance is generally less than spatial variance. Yield and economic performance measures are generally non-normally distributed. Data from on-farm. trials and from records provided by farmers regarding their own crop activities adequately supports research for the development of new technology for small farms.

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SESSION II PANEL REMARKS

Cornelia Butler Flora, Department of Sociology, Anthropology, and Social Work, Kansas State University, Manhattan, KS:

Glenn Johnson set the tone of the symposium on small farming systems by stating that small farm research is revolutionary. It forces us to step outside the mode of "normal science," of dependence on logical positivism, to address normative questions that relate the way the world is with the way the world should be. The crucial element in our evolving welfare measures (in contrast to gross economic measures) must be the small farm family. (Since small farmers unite the units of production and reproduction, we cannot assume that the farmer is male or that the farmer is an individual unit.) By choosing to do small farming systems research, the researcher makes a choice for the marginal small farmer and for the continued survival of the small farm family within a larger system, where most "rational" analysis argues for the small farm withering away or differentiating into larger farms or landless workers. By choosing small farming systems research, one also chooses an active, rather than contemplative, stance toward the object of study.

That small farms may seem irrational in a modernizing system of agricultural production does not mean that they are irrational internally, or within the micro-socioeconomic systems that contain them. Charles Francis' paper makes this quite clear. Francis shows that rationality is a relative term and that criteria for rationality vary according to one's social position, including both social class and national background. He also points out that rationality for a larger system—or those that run it—may be exceedingly irrational (if the measure of rationality is something as simple as a bivariate variable of survival or non-survival) from the point of view of the farm family. Part of FSR is learning those criteria the farm family has for its own internal rationality and plugging our technological innovations into that rationality.

Francis also points out the knotty problem of non-market rationality in small farming systems research. When something is sold, and when one purchases inputs, rationality can clearly be calculated as a simple monetary balance at the end of a cropping or animal growth cycle; but when the market makes up a moderate or neglible part of the production/distribution process, our calculations of rationality are thrown off, and our tendency to call the farmer and his/her family irrational increases. The researcher is forced into changing his/her methodology and measures—something much, more threatening than a farmer changing his/her crop rotation. In many ways, researchers are as traditional—or maybe more so—as the farmers they are paid to serve.

Francis has systematically demonstrated that the small farm family's rationality is multidimensional-responses to it must be interdisciplinary Not only must the animal breeder and the agronomist work together, the economist and sociologist must contribute to the team. We are all needed to see the splinters in the eyes of the other disciplinary approaches, who in turn point out the sticks in our own.

Uphoff, with his emphasis on participation and group process, makes clear that we should not deal with farm families in isolation, but that farm families form homogeneous groupings that can articulate their needs and resources. If we use his useful typology of phases of participation; we are less likely to impose our own rationality on the small farm family. Particularly important is participation in the decision-making part of a small farm development program this is the phase in which criteria of rationality are set. If we fail to

include the farm family at this stage, including it in the implementation and benefits stages will be an empty gesture. Unless the farm family participates in the evaluation phase of a project (if we don't include a feedback mechanism based on the farm families' own criteria of rationality), we will be unable to say what all our efforts have brought about. The absence of such feedback means that we are less likely to be able to assess the negative impacts of changes. Our own frame of reference, based on our logical positivistic assumptions, builds in blinders to the spectrum of latent possibilities.

Participation assumes a commonality among the participants. The tendency of researchers who include a participation phase in their process is to use the village as the base for that commonality, Yet, anthropologists have shown us the wide diversity of interests—and, thus, criteria of rationality—within a village that looks monotonously homogeneous to the untrained foreign eye. Organization of participation must include awareness of differences by social class, particularly tenure status, sex, ethnicity, and location of residence.

Participation, an often neglected part of small farming systems research and action, has, according to Uphoff, three objectives: (a) increase in efficiency, (b) increase in equity, and (c) empowerment of the dispossessed. Small farm families are, by definition, marginal. Governments, even more than farmers, have a proven risk aversion tendency. Indeed, in such countries as Colombia, when a development program included participation, the resulting organization—the Association of Users of Government Services (Association de Usuarios)—initiated to provide the Liberal party a rural base in areas dominated by the Conservative party, gained so much power it quickly lost official sanction. The government's criteria for rationality (which, like the farm family's, included a large emphasis on survival) had not been met.

The problem of participation and of recognition by those developing and providing technology of the farm family's criteria for rationality (and thus their needs) is shown in the IRRI example presented by Edwin Price. The link between researcher and farmer, in getting new knowledge out to the farmer (the implementation part of participation), is in place, although the separation of farming systems research from extension means that there are still problems in this linkage (IRRI's mandate as an international research center limits its extension function). The link between farmer and researcher is there, In terms of the evaluation stage of participation; but because there is not the prior participation to include farmers in the decision-making participation, the criterion of rationality may not be that which meets the needs of the farm family. If researchers depend on the political or the market system to determine the direction of the research, as Price has indicated, it is doubtful that the research undertaken will meet the needs of marginal small farmers—by definition, they are outside these two systems. Thus, there is particular need for small farming systems research to devise methodologies that, through awareness of the disarticulation of the small farmer with the national system, attempt to determine the kinds of agricultural innovations that fit best before the agronomic research is undertaken.

In summary, people involved in FSR focused on the small farmer can no longer do "normal science" (to use Thomas Kuhn's term). Like the farm family whose survival concerns us, we must remake the world of our neat, separate disciplines into a complex, if slightly messy whole, The interdependence of system parts must again be recognized: this calls for interdisciplinary research and cooperation. The changes that we make are first in our heads, and then in the farmers' fields. This, Kuhn tells us, is part of the process of scientific revolution.

Berl Koch, Department of Animal Sciences and Industry, Kansas State University, Manhattan, KS:

1. Can we dignify the small farmer by referring to "him" or "her" as the small farm operator?
2. We have interviewed, dialogued, categorized, targeted, base-lined, classified, domained, indexed, analyzed, stratified, rationalized, and participated the small farm operator. We have not helped him very much. Even Dr. Norman, who used his eight minutes and my seven minutes this morning, spent only 45 seconds talking about helping the small farm operator.
3. All three speakers have stressed the fact that we must involve the small farm operator. However, it seems to me that involvement is like the missing diagrams in one paper... it is assumed to be there.
4. Dr. Francis mentioned the problems involved in getting acceptance for soybeans—I can remember when we first planted soybeans in Iowa. Even though we were putting them on land the government paid us not to plant in corn, acceptance was very slow. Likewise, high lysine corn has not been a howling success in this country to date.
5. I have seen IRRI's efforts with the small farm operators. I am impressed—I think it is an effort in the right direction. But, I wonder if we should call it demonstration rather than research, from the farmer's point of view.
6. I am the eternal optimist; I think we will help the small farm operator...someday. When we do, it will be because we do properly the "mundane" things Dr. Johnson mentioned this morning. Too often, I think of the project leader who spent three months looking for the house with adequate space to entertain ministers and three days touring the project area to see what might be done to help the small farm operator.

L. Van Withee, Department of Agronomy, Kansas State University. Manhattan, KS:

I have been impressed with the comprehensiveness of the statements made here, and that, of course, is highly laudable. It happened by design; it was intended that this conference be as comprehensive as possible, that it deal with the problems of small farmers wherever found on earth. However, this comprehensiveness may, for some, be oppressive. It leads to a depressingly long list of concerns and this, in turn, may lead to a feeling of unmanageable complexity. This need not be the case. The problem will be with us a long time and it will require enormous effort to remedy, mostly by those who find themselves in the circumstance of a small farmer, but also by those whose ambition it is to somehow assist the small farmer. There is a great deal that can be done by individuals or institutions having the responsibility or the inclination.

As I listened to Dr. Francis talking about rationality, I wondered to what extent management decisions are made on some other than a rational basis. To what extent are decisions made on the basis of tradition and culture? Of course, in every country-developing or developed-tradition and culture are important. Let me give you two examples from my experience. Several years ago a student in a course that I teach became interested in the discussion of ecofallow in a wheat-sorghum-fallow cropping system—a system using herbicides and a reduced number of tillage operations. He asked questions as if he were

considering adopting the practice, and he discussed the matter with his father. He would terminate our conversations by saying, "We'll just have to talk to the uncles." Evidently, the decision regarding adoption of the practice would be made on the basis of a community of interest—on the basis of what would be rational for a group of people.

I frequently receive notices from the university placement center for jobs available for graduating agronomists; among the qualifications given is the simple statement "farm background preferred." What that qualification suggests, I suppose, is a preference for a certain work ethic possessed by candidates and the desirability of their possessing a frame of reference in which knowledge of agricultural technology is set. It suggests, that the technically trained individuals should share the outlook and goals of the clientele and understand their limitations and mode of problem-solving. It would be desirable if the individuals sought had an understanding not ordinarily produced by a given curriculum, but by a culture or subculture.

Sometimes the problem of introducing rationality is one of overcoming inertia. One of the means of introducing rationality given by Dr. Uphoff was by participation. We know that arranging for increased participation takes enormous skill and patience. In his paper, Dr. Uphoff said there were two sets of factors affecting the relevance and feasibility of different kinds *of* participation and "These...factors are complicated because of their number and their interactions which have not been systematically analyzed for their effects on participation outcomes. Discussing what knowledge there is about such factors would be a paper in itself...." Such a paper would be a worthy endeavor, useful to many of us.

SESSION II QUESTIONS

Question directed to Norman Uphoff by Earl Kellogg, University of Illinois, Urbana, IL:

One observation I have made regarding participation of rural people in rural and/or agricultural projects in LDCs is that the personnel implementing the projects are not trained in encouraging, managing, and utilizing participation by the rural people. Is this observation, in you view, generally correct? If so, is it important to train agriculturalists who will be implementing projects in encouraging, managing, and utilizing participation? If so, how do we in universities do this? Is there a body of knowledge adapted to this situation to improve agricultural administrators and project personnel?

Response :

The observation is generally correct, but I would add that I think the problem is as much in the area of attitudes and philosophy—presuming that educated people have nothing to learn from uneducated ones, as in the area of skills. Thus, the work of universities might as well focus on the attitudes and philosophy they impart to those whom they educate. Do universities foster and perpetuate educated elitism? Universities can well alter attitudes by paying more attention to things like ethno—science, underscoring the intelligence and sophistication manifested in many (not all) indigenous practices. (The Philippine slash-and-burn system Dr. Popenoe talked about, where over two hundred cultivars are intricately utilized in a complex system of stably exploiting a fragile land base is a good example of this.) Until attitudes toward the uneducated are changed, communication and other skills are not likely to have much effect. Assuming such improvements are being registered, universities can well provide some training on understanding and analyzing peasant society and agriculture for all persons working on problems related to agricultural development (from whatever discipline). Some community organization techniques can be imparted in courses for this purpose. Agriculturalists should get some training in administration, given the high probability they will have administrative responsibilities sometime, somewhere. They should also have some training for work with people, not just plants or animals.

Question directed to Norman Uphoff by Thomas Hobgood, USAID/Philippines:

Dr. Vincent pointed out that the definition of the target population will vary, depending upon the institution involved. I would also like to note that the organization, behavior, and orientation of most institutions involved in FSR are not conductive to carrying out the interdisciplinary approach required, nor to involving farmers in a meaningful way as part of a research team. I would like to see FSR work pay more attention to this issue and document attempts to change the orientation of bureaucratic institutions which have enabled the theory of FSR to be translated into real, implementable programs. Has any work been done, or is any currently underway, in this area?

Response:

There appears to be little systematic work on this, though there are some good examples of experimentation that has shown some success. Experience

in Guatemala and Honduras along these lines is analyzed by William F. Whyte in the state-of-the-art paper "Participatory Approaches to Agricultural Research and Development" (Rural Development Committee, Cornell University, Ithaca, New York, 1981).

Question directed to Ed Price by Uijay Kumar, Department of Agronomy, Colorado State University, Fort Collins, CO:

(a) How can you make farmer's fields an open lab? You have to test things first on an experiment station and then demonstrate them on farmers' fields if the experiment was a success. To test the experimental material against variability, you have experiment stations all over the country. (b) How can you distinguish between demonstration plots and on-farm research?

Response :

(a) It is not difficult to use farmers' fields for experiments. First you select a field that displays the characteristics you are interested in—soil, water supply, drainage, pest exposure, crop history, etc; then explain the experiment to the owner—normally he would have already volunteered to take the particular experiment; then closely supervise all operations on the plots and take yield samples. The farmer can perform most operations, but usually research staff will apply any chemicals included in the treatment. Results of experiments in farmers' fields usually display higher coefficients of variation because of variation in uncontrolled factors across farms, such as other operations performed on the plot, i.e., outside the treatment.

It is simply my view, and that of many others in FSR, that experiments need not be done on experiment stations. In many cases in developing countries, no experiment station has the physical conditions—soils, water, pests, etc.—for which we wish to design and test new technology. What do you do then, build experiment stations for every microenvironment? It's much cheaper, and proven successful, to experiment on farmers' fields.

(b) A demonstration plot is normally used to show the use and results of a proven technology. The intent is to persuade farmers to follow the new technology, and there is a high probability the results will look good to farmers. An experimental plot on a farm, similarly as one on an experiment station, is not intended to persuade farmers, nor is there a high expectation the results would look good to farmers. It's a genuine scientific experiment in which crop failure is as acceptable a result as crop success. The objective is normally to compare alternatives and eventually select a technology that appears well-suited to conditions where the experiments are conducted.

Question directed to Ed Price:

How would you look at this situation, which I am inclined to believe is true and actually occurs? There are two farmers—one is near a cluster of research institutions and the other at a very great distance from these institutions. The farmer residing near the research institutions is very receptive to new technology. He is provided with a packaged technology; but before he gets to confirm the benefits he can derive from it, he is already fed another new packaged technology to try out. He fails to get a real feel for the advantages from the first technology before he receives the second. The other farmer (who is also receptive to new technology) may evaluate a packaged technology on his farm over a long period of time before

new ones come into his grasp; he would have proven the worth of the first one to his economic well-being. Where should the compromise be in this case?

Response :

I agree that farmers can contract what I call "development fatigue" from exposure to too many programs, particularly if they are continually disappointed in their results. They may become cynical and despairing of making any improvements in their livelihood. I don't know how widespread or harmful the problem is. On the other hand, farmers also learn to manipulate programs to their benefit. For example, they may not worry about following through on commitments they make in return for loans or other benefits because they know the program will die anyway, then a new one will come along. Of course, these points have to do with the organization of rural development and not technology itself. More to your point, I would guess that if the technology packages were good, the farmer who tries many, one after another, is better off—even if he doesn't come to fully understand each technology—than a farmer to whom new technology is seldom introduced. This assumes that the former learns and correctly uses at least something about each new technology.

Question directed to Ed Price by Tony Mercado, Agronomy Department; Emil Gianzan, and Ricardo Lantican, Institute of Plant Breeding, University of the Philippines at Los Banos:

Why do Philippine farmers have so much difficulty in producing tilled crops, especially sorghum, soybeans, and mung beans (other tropical and subtropical countries have the same problems)?

Response :

Philippine farmers, as well as those of many other tropical and subtropical countries, have difficulty producing crops such as soybeans and sorghum mainly because the available varieties are not adapted to temperature, daylength, moisture, pest, and disease regimes found in the tropics. Much more work on the breeding of these crops for the tropics is needed. While mung beans are fairly well-adapted to tropical growing conditions, it is likely that they can be significantly improved by concerted breeding efforts, say on the scale of the International Rice Research Institute's work on rice, which twenty years ago was also a generally lower-yielding, but well-adapted, tropical crop. Good work on tropical grain legumes is already being done, but the few people doing it are forced to work on a range of crops and a range of environmental conditions. More support would permit greater specialization and concentration of effort.

Comment directed to Ed Price:

As you pointed out, on-farm research is practical? from many viewpoints, such as researchers transferring information to farmers as well as obtaining feedback. It seems that this type of research is very costly.

Response :

I think it would be useful to conduct an analysis of the costs and benefits of various research approaches. The problem would be controlling for the type of technology produced, type of client, and perhaps other external factors that would affect the benefits and costs one observes. For example, some believe that most of the advances in production that can be made with

easily disseminated technology, such as new crop varieties, has already been made and, necessarily, future production increases will come from more finely-tuned, environment-specific technology—costlier to produce, less generally applicable, and harder to introduce.

In other cases, on-farm researchers tackle technical problems that past research has not been able to solve, or made little contribution. this might be because of problem environments—flood-prone, drought-prone, remote or low-cash situations—where modern technology has made no inroads.

While neither of these cases precisely describes on-farm research, particularly FSR, some of their elements are evident in our research at the International Rice Research Institute. It is true that our cropping systems research is regarded as a way of gaining additional benefit from available rice technology by developing complementary inputs or techniques in and for specific environments. The two kinds of research, reduced-factor technology from experiment stations and multifactor technologies from on-farm research, go hand-in-hand. One may not be a substitute for the other, and a comparison of the costs and benefits of the two may not be meaningful or, at least, controlling for their different clients or other features may be difficult.

This is an assertion, but, in my view, cropping systems research is most cheaply conducted on farms. I recall that we budgeted $30,000 per year for expenses (field staff, materials, travel, etc.) for each of the first three years of work at our Iloilo site. This excluded services of Los Banos staff who supervised or consulted on the work. Techniques of direct seeding and, hence, multiple-cropping were identified in the first year and refined thereafter, and are rapidly spreading throughout the Philippines. At the site itself, rice-cropping intensity on rainfed land increased about 30%, and intensity of all crops about 70%.

Question directed to Jim Converse:

Who should decide what "small farmers" need and how should it be decided? I expect that the worst thing we could do would be to help them become large farmers and, therefore, displace many others who must find other jobs. Should we, perhaps, look in detail at the situation in developed countries that have a high percentage of farm population? We have developed a highly economically successful farming system in Kansas, but it is very anti-social (we have removed the farmers, put them out of business, and they have moved to the city). How do we prevent this in the developing countries?

Response :

Small farmers should have at least some say in deciding what they need. The concern raised in the question about their wanting to become large farmers does suggest that other sectors of society—in the United States. and also abroad—also have vested interests in maintaining some small farmers in business. Increasingly, the small farmers who have survived the many years of farm expansion (what I call rural cannibalism—swallowing up adjacent farms) now want ways to increase their income on their farms as they presently exist.

Many consumers show increasing levels of awareness of the role of small farmers in maintaining food production from sources closer to home, as well as a feeling (not always based on fact, but often true) that smaller farmers use less chemicals and provide healthier, fresher food. These people help small farmers decide what to grow by showing up at roadside stands, community

farmers' markets, and other places. Voting with your dollars is probably going to do more in the long run than all the arguments about who grows the best food.

Government agencies increasingly have to justify their existence. (One joke about the number of USDA employees surpassing the number of farmers does not raise many laughs in Washington.) One could envision an agricultural researcher or extension agent having to sell their services door-to-door and at some point deciding they could make more money farming.

It is hard to draw parallels with small farmers in other countries. Many U.S. small farmers make the major part of their money from off-farm work—part of the reason they can sell their food so cheaply. (They treat the production-for-sale-locally as emergency income while awaiting checks for wheat, corn, etc. if they are commercial farmers. If they are part-time farmers, they often grow food as an antidote to the high levels of dissatisfaction with other available off-farm employment.) In poor countries, many people who sell food for local consumption do it mainly as a modest expansion of their normal farming/gardening operation. The danger for them is to specialize in foods they do not eat, then be forced to buy them, often at higher prices than they can pay from the sale of cash crops.

Question directed to Jim Converse:

The a symposium seems to start with the assumption that small farms are desirable—what are the implications of assuming small farms are undesirable? Is the small farm only an outlet for people who cannot or will not fit in any other social order?

Response :

A major point from the Bergland debate on the structure of agriculture A Time to Choose) is that small farms are still being forced out of business at a high rate. We do not know that it is good of bad, but by the time we find out either way, there will be many less small farmers. Points for small farms: communities with more small than large farms usually have a better quality of life; many point to increasing concentration in farms with specialized commodities, while small farms often are more diversified; pesticide and other chemical use is often lower on small farms, therefore, there is less environmental degradation.

RELEVANT TECHNOLOGY DEVELOPMENT AND TRANSFER FROM LAND GRANT INSTITUTIONS

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The word "technology," derived from the Greek work technologia, refers to the systematic treatment of an art; alternatively, it might be described as a technical method of achieving a practical purpose; or perhaps—better still—as the totality of the means employed to provide objects necessary for human sustenance and comfort.

Currently, we hear much about technology. We hear an increasing amount about the transfer of technology from the developed to the developing country to speed economic improvement. On the domestic scene, the United States Congress has established an "Office of Technology Assessment" to deal with critical issues confronting our country. One such issue is that dealing with food and water in the United States.

Before discussing technology development and transfer as it relates to the developing country, it is appropriate to review significant technology developments and transfers affecting the United States over an extended period. Following are some random examples:

Invention of the steel plow. The first plow patented in the United States was a cast iron plow (1797). Forty years later, in 1837, John Deere was issued a patent for a steel plow having a moldboard made from a saw blade.

Discovery of the laws of genetic inheritance by Gregor Mendel was reported in 1865. But, it was not until 1900, after they were confirmed by three other scientists, that attention was paid Mendel's writings and their potential was realized.

Discovery of DDT occurred in 1874, but was not used as an insecticide until 1935—some 60 years later.

Synthetic nitrogen fixation was the subject of concentrated research, especially in Germany, during the period 1900-1910. This research paid big dividends for Germany, and, by 1913, synthetic ammonia was used to produce munitions for World War I. The United States experienced great difficulty in establishment of such technology. A first plant failed after one day's operation. At the start of World War II, the United States had only one small functional ammonia fixation plant. Under pressure for more synthetic ammonia, the U.S. government authorized construction of additional plants. These functioned properly and, even before cessation of World War II hostilities, the U.S. government was able to release surplus ammonium nitrate to increase farm production.

Hybrid corn was considered a possibility at least as early as 1888. In Michigan, corn varieties were crossed in an attempt to achieve heterosis. But, it was not until the period 1908-1910 that G.H. Shull was able to demonstrate actual hybrid vigor. Donald Jones of the Connecticut Experiment Station demonstrated effective use of a double cross in 1917; thus, in effect, inventing hybrid corn. However, it was not until 1933 that the Iowa Agricultural Experiment Station released the first hybrid—Iowa 939.

Corn breeding technology in Kansas followed a similar pattern. Biennial reports of the Kansas Agricultural Experiment Station note the testing of Kansas corn hybrids as early as 1916. Despite achievement of higher average yields with some hybrids than with open-pollinated corn varieties, hybrid corn was impractical for economic reasons.

The Kansas situation probably warranted this conclusion. Kansas scientists had developed a very unusual white corn variety—Pride of Saline. As a matter of fact, they had attempted for a number of years to develop a yellow variety with comparable yield capability under rugged Kansas conditions.

Crossing inbreds derived from Pride of Saline with inbreds derived from other varieties and combining these as double crosses did not produce hybrids that were substantially superior to the parent Pride of Saline variety. It was not until four inbreds—each selected from Pride of Saline—were combined as a double cross to produce Hybrid 2234 that Kansas scientists were confident in the release of such hybrid in 1942.

Atom smashing was theorized as early as 1919, but was not demonstrated to be a reality until 22 years later (1941).

Penicillin was discovered in 1929, but was not adapted as a medicinal substance until 1940. The next round of antibiotics came with great haste. Consider the following:

Sulfa drugs were identified after penicillin—Sulfanilimide in 1934, Sulfapyridine in 1938, and Sulfadiazine in 1940—and came into general use in the early 1940s.

Streptomycin, an entirely different kind of drug, was identified in the early 1940s and put into use almost immediately.

Nitrogen fertilizer recommendations in Kansas illustrate, in still another way, some of the trials and tribulations confronting technology development. During the period 1930-32, three Kansas scientists presented evidence in a well-documented technical bulletin that modest applications of nitrogen fertilizer could be applied to wheat in Kansas with beneficial results extending all the way to northwest Kansas. But, it was not until 1946 that the Kansas Agricultural Experiment Station would recommend nitrogen top-dressing for wheat. Why?

+ Kansas wheat production was in a fragile economic state for a considerable period of time—at least until 1938.
+ Kansas wheat production had to endure an extended drought, 1933-37.
+ The fertilizer industry did not offer a desirable form of nitrogen compound for top-dressing wheat until 1945.
+ Following the wheat prosperity enjoyed during the World War II period, many Kansas farmers readily accepted nitrogen fertilizer starting in 1946. By 1952, there had been at least a tenfold increase in the state's

nitrogen fertilizer usage.

Turkey Hard Red Winter Wheat was introduced by Mennonite persons immigrating from Russia to South Central Kansas in 1874. Kansas wheat acreage increased fivefold, from less than one million acres in 1873 to more than five million acres in 1893, This rapid acceptance of a new technology imported from Europe was an exception to the usual example. Why?

+ Incentives provided by the Santa Fe railroad provided sufficient economic input for the Mennonites to make the move.
+ Human resources (the Mennonite immigrants) certainly were sufficient to enable the survival of the technology transfer.
+ Natural resources of South Central Kansas (reasonably stable precipitation and high quality soil) favored the survival of the new technology (hard red winter wheat production).
+ The art of milling hard red winter wheat was introduced simultaneously with the introduction of the crop, thus insuring that it could be converted into food.
+ The prevailing political situation in the United States regarding compulsory military service was certainly more palatable than that of Russia.

Development and Delivery of Appropriate Technology

From the above discussions, it becomes apparent that effectiveness of technology transfer is determined by interaction of numerous factors. Factors playing important roles in transfer of agricultural technology include the following:

1. Relative priority accorded the technology by the developing country.
2. State of the art in the developing country.
3. Natural resource availability.
4. Human resources.
5. Economic considerations.
6. Political stability.
7. Sophistication of relevant sciences and technology in the country.

Frequently, states like Kansas, Nebraska, Oklahoma, South Dakota, Texas, and Colorado are considered for lead roles in the transfer of dryland farming technology to developing countries in Africa and Asia. There are historic and other compelling reasons why these states are so considered. A few brief comments serve to document the facts:

+ The former Division of Dry Land Agriculture, Bureau of Plant Industry, U.S. Department of Agriculture, established a network of dryland research stations in 1910 in cooperation with the agricultural experiment stations in the above-listed states to investigate the dryland situation and to formulate recommendations for management of the same.
+ By the early 1940s, it was obvious that recommendations, centering mostly around a system of alternate crop and fallow, could be made to insure survival of the dryland farmers.

+ The 1950s and early 1960s certainly demonstrated the effectiveness of such recommendations.

+ Production records of the 1970s clearly indicate that some dryland. portions of these states probably produce wheat more efficiently than continuously cropped lands situated immediately to the east.

How long is it going to take to perfect dryland farming technology in the developing countries of Africa and Asia? Certainly longer than the five years so commonly allocated development projects. Some considerations follow:

1. The federal and state governments accorded high priority to the United States' dryland research program. It is hard to visualize this kind of commitment by governments of countries involved today.

2. The state of the art in today's developing countries is not as advanced as that of U.S. farmers 70 years ago.

3. Natural resource availability is not as good in the developing countries as it was in the United States in 1910. While vast areas of drylands prevail, they do not have the deep soils found in our dryland farming regions. Also, there are generally not nearly the reserves of fossil fuels and fossil soil organic matter to be exploited for use in power machinery or in substitution for nitrogen fertilizer.

4. Human resources are abundant, however, they will need great assistance in developing the art.

5. Economic considerations are indeed extremely challenging. Most developing countries do not have sufficient resources of their own, but, optimistically speaking, dryland development efforts today are likely to provide much more credit than ever before possible.

6. Political stability in dryland countries is frequently dependent on production of necessary food grains. Presumably, developing countries seeking U.S. assistance have been able to demonstrate necessary stability.

7. Sophistication of relevant science and technology in developing countries is frequently lacking. Fortunately, most dryland agricultural projects also contain provisions for both long-term and short-term training.

Not all technology transfer difficulties concern dryland agricultural problems in developing countries. Quite the opposite may prevail with crop production in a tone of high annual precipitation—the Philippines, for example. It has become obvious that rice culture in the Philippines has benefited. enormously by transfer of relevant supporting information pertaining to insect and disease control, fertilizer needs, etc.

At the same time, it is quite obvious that relevant technology pertaining to maize production has not been so readily accepted in the Philippines. Average yields for the maize crop are but a small fraction of those achieved in the United States—as a matter of fact, only a fraction of those generally achieved 30 or 40 years ago. Why so?

+ Apparently, maize is not generally accorded those inputs necessary to achieve high yields—weed control, insect control, disease control, and use of necessary fertilizer.

+ Apparently, much of the maize is not even planted in rows—it is broadcast

by hand.

+ Apparently, decision-makers who provide crop production recommendations have not even been able to decide which type of corn seed should be employed—from among open-pollinated varieties, hybrids, or germ pools.

+ Considering the great care that is given the rice crop, it is almost inconceivable that maize could be managed so loosely.

Establishing Priorities for Technology Transfer

A major challenge concerning technology transfer is that of establishment of priorities pertaining to actual accomplishment of the technology adoption. Oftentimes, as a matter of national pride, a developing country may choose a technology well beyond its own capability or beyond its economic capability.

Consideration of the following alternatives—each of which might address the decision-making process concerned with formulation of fertilizer recommendations to increase food grain production—would undoubtedly evoke discussion:

+ Utilization of sophisticated analytical chemistry capability has come a long way in the United States, Western Europe, and parts of Asia (especially Japan). Why shouldn't a developing country expect to acquire such expertise and equipment? There are numerous causes for concern: (a) lack of expertise among the science disciplines necessary for the operation of sophisticated instruments; (b) great initial cost of acquiring such equipment; (c) lack of service capability in the developing country for maintaining operation of the equipment;(d) lack of stable electric current delivery to enable precise and accurate results to be delivered; and (e) inability to apply many measurements to any practical recommendation.

+ Utilization of applied soil chemistry (perhaps better understood as soil testing) prevails, to a great extent, in government agencies, such as state experiment stations, state extension services, and in commercial agencies and enterprises. What about this for the developing country?

  It should be recognized that today's soil testing techniques have emerged only after many years of correlation of such tests with actual differential nutrient applications made under field conditions. It would be a technical disservice to recommend establishment of a soil testing laboratory before the field testing had even been undertaken, let alone been properly calibrated.

+ Field fertilizer testing as pertains to various rates of nutrient application and to various combinations of plant nutrients is an absolute essential. Such research, precisely and thoroughly done, will deliver quick results that can be converted into tentative fertilizer recommendations within two or three years and that can provide necessary calibration of fertilizer application rates based on soil test results after five or six years.

First Things First

Following selection of a major agricultural enterprise for achievement of technology transfer, decisions still have to be made as to which sectors to involve.

If dryland farming is again considered, there will be a great desire to demonstrate increased food production. Also, there will likely be urgency in attaining measurable results. How can these goals be achieved? Some alternatives to be considered are:

1. increased use of fertilizers
2. development of improved crop varieties
3. adaptation of more sophisticated agricultural machinery
4. simple alteration of seeding rates.

The first three alternatives require additional capital outlay and take considerable time for development. The fourth alternative is so simple it is likely to be ignored.

Consider some possibilities:

Wheat production in highly developed agricultural production systems commonly achieves production increases of 35:1 when the ratio of harvested grain to seed planted is considered. But, developing countries will likely achieve no more that a 10:1 multiplication. Why?

Obviously, no single cause prevails; but, excessive seeding rate is a major factor. Under prevailing conditions a typical developing country is likely to use 10% of its harvested wheat to produce the next crop; efficient Kansas dryland farmers use only 2-3% of the harvested wheat crop to seed the next crop.

What might it mean if the typical developing country, with its 20 million population, could reduce the seeding requirement initially just 5% of the harvested wheat crop? It would give the equivalent of a 5% increase in domestic wheat to be used as food; or—putting it another way—it could save the equivalent of more than 7% In purchases of imported wheat. The same considerations could be applied to barley production in the same country and bring about the same kind of improvement.

Why not try first things first?

Summary

1. Technology transfer, at least initially, has never been a rapid process. It can be expected to be more rapid, worldwide, in the future than in the past, but not necessarily much more rapid in the developing countries.
2. Proper assessment of the state of the art of most proposed technology transfers can reduce, and perhaps even avoid, many failures.
3. Establishing priorities for various technology transfers or even for various components of a given technology transfer should pay big dividends for administrators of aid programs for the developing countries.

RELEVANT TECHNOLOGY DEVELOPMENT AND DISSEMINATION FROM THE INTERNATIONAL AGRICULTURAL RESEARCH CENTERS

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Introduction

Relevancy of technology developed at the International Centers sponsored by the Consultative Group on International Agricultural Research (CGIAR) to farming systems in developing countries is of concern to many. There is no doubt that research from the Centers has contributed to food production; however, some observers hold the view that small or subsistence farms have been hindered rather than benefited from the new technology. Among other expressed concerns from the target countries are: technology not reaching farmers; competition between the Centers and developing countries for donor funds, thereby inhibiting development of national programs; limited focus of Center programs, e.g., technological solutions to world food problems are not value neutral when applied.

There is validity for the International Centers and their current approaches, but there also appears to be rationale for induced changes. This discussion will deal with an overview of the thrust of the Centers and some of the factors limiting the functional efficiency of their programs for small farm operations.

Consultative Group on International Agricultural Research

The CGIAR is an international consortium that seeks to increase food production in the developing world through research programs and through the training of research scientists and production specialists in developing nations (CGIAR, 1976). It was organized in 1960, but really began functioning as an advisory and funding source with support to five Centers in 1972 through contributions totaling $15 million. By 1981, the CGIAR network had grown to thirteen international agricultural research centers or associated organizations. Funding increased to $143 million in 1981.

The CGIAR operates informally and by consensus. It reflects cooperation between the industrialized and developing countries. Headquarters' offices are furnished by the World Bank in Washington, D.C., which also provides the Chairman and the Executive Secretariat. A Technical Advisory Committee (TAC) to the CGIAR is provided by the Food and Agriculture Organization (FAO) of the United Nations (CGIAR, 1976).

When considering the output of the Centers, it is important to recognize that the CGIAR is an informal group that has assumed "general responsibilities" for support and policies of the Centers, but not direct control. Most Centers are organized as autonomous, philanthropic, nonprofit corporations licensed in the countries where their headquarters are located, such as the Centro International de Agricultura Tropical (CIAT) in Colombia. Besides agreements with the "host countries," most of the Centers have sub- or outreach-programs in other countries under memorandums of agreement, e.g., the International Livestock Centre for Africa (ILCA) located in Addis Ababa, Ethiopia, has operations in

Botswana, Kenya, Mali, and Nigeria. Location and a brief description of the Centers are in Figure 1 and Table 1.

The TAC makes an annual review of programs and budgets for the Centers. At five-year intervals, programs and mandates of the Centers are reviewed by outside teams selected by the TAC. A Board of Trustees serves as the policy-making body of each Center. Membership is drawn from both developed and developing countries. The Boards and their committees decree the budget, establish goals and general priorities for work, and review progress.

Donors to the Centers through the CGIAR are many: governments; international agencies, e.g., U.S. Agency for International Development (AID) and the United Nations; international or regional banks; foundations and certain other groups. Donors may choose the Center or Centers they wish to support, which means donors could influence programs to some degree. Through the CGIAR, the Board of Trustees, and outside review teams, the programs of the Centers are subject to review of progress similar to that for most universities in the United States.

A pertinent question is whether the structural organization of the Center network system insures relevancy to farm needs. Are programs of the Centers determined too much from the top down? The titles and positions of the sixteen members of the Board of Trustees for CIAT in 1980-81 (Table 2), for example, suggest possibly more concern with national policies than firsthand knowledge of farmer needs.

A point of concern to a team reviewing the CGIAR system during 1981 will be its organization. Should it be restructured to assume a greater role in technical development? Should activities of the present Centers continue to expand and others be established, or should there be a celling for CGIAR supported activities? The projected budget for CGIAR in 1982 is over $160 million, representing a growth rate of 1080% in ten years.

Research Programs

Nine of the Centers concentrate on the development of subsistence food crops, one with animal production and one on animal health, in the north-south 30° latitudes of the world. Two of the initially supported Centers (IRRI and CIMMYT) were set up under the auspices of the Ford and Rockefeller Foundations, with emphasis on purely biological research. These Centers have since shifted from emphasis on developing technology for intensive farming programmed for high levels of inputs, to emphasis on plant types and technology packages more appropriate to the production constraints prevailing in subsistence farms. Following a review by the CGIAR's Technical Advisory Committee in 1978 (TAC, 1978), the Centers made a further shift to increased emphasis on farming systems. These trends reflect sensitivity to needs for change in emphasis or approach.

With the broad diversity of research underway at the Centers, there is tenuity in generalizations; nevertheless, certain common features are evident, in general) the functional scope of research by the Centers concerned with plants is towards increased total production, productivity, and quality of selected basic food crops. Increased production is achieved through better technology to bring new land into production, and increased productivity is achieved through a rise in output per unit of land, Consumer acceptance is of importance, but postharvest factors, such as processing, storage, and marketing, are encompassed in the functional scope only when they improve on the adoption of improved production technology. Technology developed at the Centers is

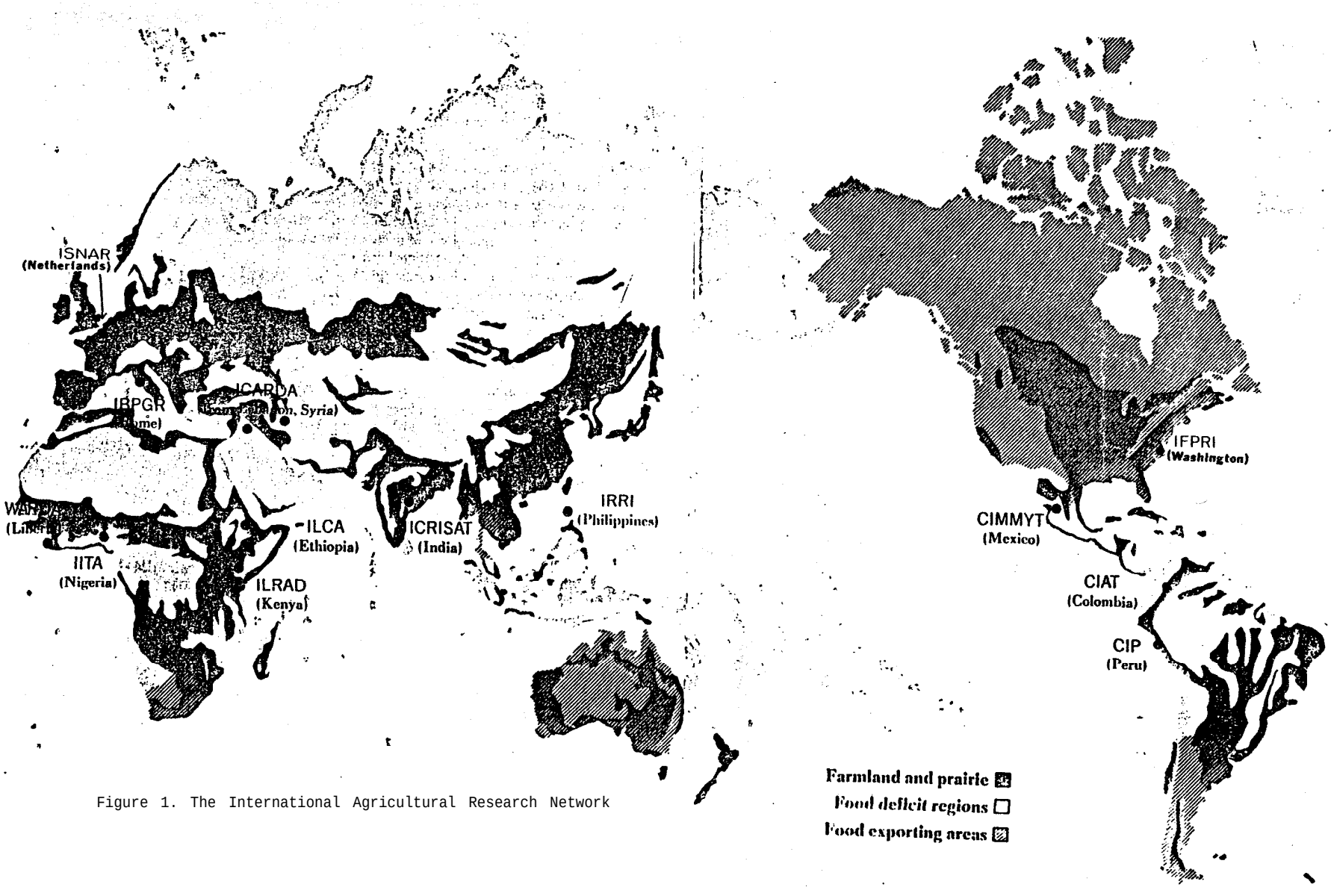

Figure 1. The International Agricultural Research Network

Table 1. Name, location, and main program of eleven CGIAR sponsored Centers

Center	Acronym	Joined CGIAR	Program
International Rice Research Institute, Los Banos, Philippines	lRRl	1960	Rice, multiple cropping
Centro Internacional de Mejoramiento de Maiz y Trigo (International Maize and Wheat Improvement Center) Mexico, D.F., Mexico	CIMMYT	1966	Wheat, maize, barley, triticale
Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture Cali, Colombia	ClAT	1967	Beans, cassava, beef and forages, maize, rice, and swine
International Institute of Tropical Agriculture, Ibadan, Nigeria	IITA	1968	Maize, rice, cowpeas, soybeans, lima beans, cassava, yams, sweet potatoes, and farming systems
Centro lnternacional de la Papa (International Potato Center), Lima, Peru	CIP	1971	Potatoes
lnternational Crops Research Institute for the Semi-Arid Tropics, Hyderabad, India	ICRISAT	1972	Sorghum, millet, peanuts, chickpeas, pigeon peas
International Laboratory for Research on Animal, Diseases, Nairobi, Kenya	ILRAD	1973	Blood diseases of cattle
International Livestock Center for Africa, Addis Ababa, Ethiopia	ILCA	1974	Cattle production
West Africa Rice Development Association, Monrovia, Liberia	WARDA	1974	Rice
International Board for Plant Genetic Resources, Rome, Italy	IBPGR	1974	Coordinate collection and exchange of plant genetic materials
International Center for Agricultural Research in the Dry Areas, Beirut, Lebanon	ICARDA	1976	Wheat, barley, lentils, broad beans, oilseeds, cotton, and sheep farming

Table 2. Title and position of members Board of Trustees for Centro lnternacional de Agricultura Tropica (CIAT) 1980-81 (16 members)

Head, Agri. Dev., Federal Min. Econ. Coop., Germany
Dir. Agri., Rockefeller Foundation, U.S.
Dir., lnstituto Nacional de lnvestigacion Agricola, Mexico
Dir., Centro de lnvestigaciones en Arroz y Frijol, Brazil
Rector, Universidad Nacional de Colombia, Bogota
Gen. Mgr., lnstituto Colombiano Agropecuario, Colombia
Regional Dir., Ford Foundation, India
Vice Chancellor, Univ. New England, Australia
Lawyer and Dir., El Siglo, Colombia
Program Officer, Ford Foundation, U.S.
Professor, National University, Mexico
Minister of Agriculture, Colombia
Dir., Res. Center in Tropical Agri., Japan
Instituto lnteramericano de Ciencias Agricola, Costa Rica
Dean, Faculty Agri., Univ. West Indies, Trinidad
Dir. General, CIAT

Source: TAC (1978)

envisioned as contributing to increased production while recognizing the importance of other factors, e.g., human welfare. Usually, the "food crop" teams include engineers, entomologists, and soil scientists for development of improved cultural practices (CIAT, 1981; ICRISAT, 1978). By and large, the research is designed to be scale-neutral; if not biased towards subsistence, at least not away from them (CGIAR, 1976).

The Centers recognize three stages in the research process: (a) scientific investigations and technology development; (b)regional adaptation or site-specific testing; and (c) farm adaptation. Stages (b) and (c) are intended to provide feedback to stage (a) Except as part of their research process, the Centers do not work directly with farmers, as this is deemed the role of the national agricultural agencies of the various countries. Regional service staff from the Centers are frequently outposted from central headquarters to achieve the objectives of technology testing and transfer to regional levels. Their major role is to assist in the inter-institutional transfer of Center-generated technology to site-specific conditions. In close collaboration with national programs, the service staff conducts or encourages research on problems of special importance to that area. The Centers also establish and maintain international nurseries of plant materials to serve as germ plasm resources in their research as well as for national institutions.

On-farm validation of improved seed and/or "package technology" measures productivity of "new planting materials;" identifies factors limiting yields which may not have been evident in designing technology at the Centers; and provides an assessment of potential constraints to adoption of the new technology. Because the mandates of the Centers are to work with the national agencies, their activities with small farmers are largely confined to this stage of the research process. Researchers can simulate the climatic and soil conditions on farms, but they cannot simulate the behavior, attitudes, and receptivity of farmers to change.

Even though most of the Centers have adopted the philosophy of "farming systems research," this has largely resulted in adding an economist and a sociologist to the program research team. This approach permits a broader base for the research process, but does not constitute a shift from the Center to working directly on a large number of farms. The plant-oriented Centers have concentrated on input-output relationships and have engaged in modeling for forecasting farm use, but, as yet, scant emphasis is directed to the dynamics of technology to traditional farm systems.

Need for closer association with farmers is a continuing point of concern directed at the Centers (Hopcraft, 1980; McDowell and Hildebrand, 1980; TAC, 1978; Wortman and Cummings, 1978). A question not yet answered to the satisfaction of scientists is the stage feedback from testing technology with farmers should be included in the research process. Views on the role of farmers in developing technology vary from involving them in establishing research parameters in the earliest stages to excluding them until the technology is fully developed with on-farm validation as the final step. Those advocating early involvement of farmers have cited, as examples, low acceptance of some of the early varieties of rice and maize from IRRI and CIMMYT due to high input requirements, poor storage qualities, and undesirable eating qualities. Also, CIAT was criticized for having failed to give quality considerations in their cassava program. Among other comments are the views of McDowell and Hildebrand (1980), who contend that the Centers have not advised farmers of possible "trade-offs" in fitting new plant varieties into their systems. For instance, use of improved varieties of rice and maize may decrease yields of straw or stover, and these residues will be significantly lower in nutritive value for animal feeding. Farmers see little value in a trade-off of increased grain production at the expense of feed for their animals.

The central thrust by those recommending "late farmer involvement" is that testing on farms requires the release of technology while it is still in the developing stages—when the technology is applied on farms, it becomes subject to public scrutiny. If the technology fails on these first tests—as it well may in the early stages of development—the Center is held responsible. An experience of this type may be severe, since the "target clientele" may lose confidence and, therefore, become unreceptive when the technology is fully developed. This position seems to largely ignore the stated policies of the Centers for including farm testing in the early stages to aid in setting of research parameters.

Lack of farmer involvement may have caused errors in judgement in the development of technology. For example, under the tropical pastures program at CIAT, tests showed that a mixture of the legume Desmodium ovalifolium and the grass Andropogon gayanus gave outstanding yields of dry matter on acid soils; when established as a pasture, gains of grazing cattle were disappointingly low due to poor acceptance by the animals (CIAT, 1980). At IITA, the application of high level technology (fertilizers, improved seed, and herbicides) produced outstanding crop yields for several years, but after ten years of continuous cropping, yields declined precipitously. Low yields were attributed to changes in the physical characteristics of the soils at the Center. The conclusion was that the traditional bush fallow practiced in Nigeria is used not only to restore soil fertility, but to maintain good physical properties of the soil; hence, a crop rotation or crop-fallow program is needed.

The Center for livestock production, ILCA, was the first established by

the CGIAR. From experience, ILCA's mandate required close involvement with farmers. Initially, research was to focus on the study of traditional livestock systems with multidisciplinary field teams. Since ILCA's program got under way in 1976, it is too early to judge the merits of its approach—its plans and first years are described (ILCA, 1980).

Scientists from the United States and European countries look favorably on the programs of the International Centers. The Centers afford an opportunity for overseas experience for university staff and graduate students; serve as sources for exotic germ plasm; supply means of expediting plant selection by a second crop per year at the Centers located in warm climates; extend knowledge of plant diseases and pests; provide jobs; etc. For assistance in solving certain problems, the Centers enter into contractual arrangements with universities or, in some cases, commercial concerns in Europe or the United States. Several new varieties of crops employed in the United States have incorporated germ plasm gathered by the Centers, thereby boosting agricultural production.

Training

Training is the most effective means for the Centers to transfer research results to the developing countries. The training programs seek to extend appropriate information and skills by (a) broadening the disciplinary scope of scientific training; (b) improving technical capability of national scientists through practical experience; (c) improving planning capabilities for research; (d) improving management capabilities for planning and development; and (e) encouraging exchange of knowledge and experience (CIAT, 1981; ICRISAT, 1978; ILCA, 1979; TAC, 1978). The Centers seek to reach (a) administrators who are, or who influence, government decision-makers; (b) research and academic leaders of national institutions; (c) research scientists; and (d) extensionists. In addition, research fellows from numerous universities train with Center scientists. On occasion, deserving students are provided support for academic training (CGIAR, 1976; ILCA, 1980).

Use is usually made of several media: (a) publications and audiovisuals; (b) individual training; (c) conferences and other group activities (workshops, seminars, specialized courses); and (d) study tours on either an individual or group basis to permit firsthand experience of ongoing programs—the Centers generally pay travel and accommodation costs.

None of the Centers appear to consider direct farmer training because of the limitations of agreements with governments. They do, however, prepare certain publications and audiotutorials for use by national institutions in their programs for extensionists or farmers—to illustrate, Table 3 lists some titles prepared by the CIAT. If titles are indicative of content, farmer interest may be low due to high emphasis on results from the Centers.

How much effort the Centers should allocate to training is being examined. In the CIAT report for 1980 (CIAT, 1981), experiences in assisting in-country courses organized by national institutions/agencies were described as worthwhile in bridging the gap between research and extension efforts on the national level. The CIAT reported training 248 technicians in new cassava production techniques. Most trainees were at the level of graduate agronomists. Is this the best level to train? Are Center resources stretched too thin by this much training? Would it be better to train technicians at the CIAT headquarters in Colombia or in their own countries where training could reflect local conditions? While the Centers have no direct role beyond the transfer of technology to

Table 3. Titles of some CIAT publications and audiotutorials recommended for design of small farm technology

Publication
Economics and the design of small farmer technology (Proc. Int'l. Conf.)
Audiotutorials
Land preparation in mechanized agriculture
Basic principles for management and control of weeds in crops
Factors affecting efficiency of herbicides
Equipment for ground application of herbicides
Practical guide for chemical control of weeds in pastures
Swine management techniques for lactating sows and suckling pigs
Weed control in cassava
System for rapid propagation of cassava

Source: CIAT (1981)

national agencies, they can affect national programs by training people at certain levels.

It is clear that major changes in modus operandi must transpire before the Centers will risk bypassing national institutions in training. Currently, the CGIAR Secretariat recommends allocation of 20% of budgets to training.

Publications

The printed word is an indispensable part of the Center programs. At present, publications are the means most widely employed by the Centers for transposition of their research. The most common forms are: monographs, technical manuals, newsletters or bulletins, catalogues (plant identification), analytical abstracts, and directories (scientists active in research on a crop or in collections of plant germ plasm). Many of the publications are distributed free to institutions, libraries, and scientists, however, most Centers have begun nominal charges to defray expenses and discourage "the collectors." The majority of the publications are issued in two languages, English and Spanish, or French, which adds to the costs. Use of other languages is left to the discretion of individual governments. Titles of the CIAT publications and audiotutorials on beans, issued during 1973-80 (Table 4), serve to illustrate the areas of concentration in a crop program. These titles suggest high emphasis on communication with other scientists.

Although the Centers do not produce publications suitable for farmers, information specialists frequently assist national institutions in preparing materials for local use, due to a major shortage of national personnel in this field.

A Dilemma

The objectives of the cassava program at the CIAT were to increase plant productivity, expand cassava production and use; and reduce country dependence on the use of foreign exchange. Breeders were able to increase

Table 4. Titles of CIAT publications and audiotutorials issued 1973-80 on Beans

Publications

Bean workers directory for Latin Amer. & Caribbean
Beans offprint 1978
Field problems of beans in Latin America
Abstracts on field beans (Vol I-IV)
Evolution de la produccion de frijol in America Latina durante la últinia década
Bean production problems
Bean rust nursery results
Preliminary trials

Audiotutorials

Weed management and control in beans
Description of insects which attack beans
Insects attacking stored beans and control
Bean breeding
Morphology of the common bean plant
Bean diseases caused by fungi and their control
Bean diseases caused by viruses and their control
Techniques for isolation, identification and consideration of pathogenic fungi of beans
Bean diseases caused by bacteria and their control
Bean rust and its control
Root rot of beans and their control
Good quality bean seeds

Source: CIAT (1981)

yield markedly (up to 46 t/ha) and improve disease resistance (CIAT, 1975). The program was intended to develop technology for the benefit of small- and medium-scale producers. Cassava appeared viable due to relatively low risks and traditional use. The high yield potential was also attractive to large farms for commercial processing to animal feed and industrial products. This has led Brazil, Colombia, Cuba, and Mexico to undertake programs to increase production of cassava, but such programs were not applicable for implementation to small producers.

With the exploitation of cassava for industrial use, it is likely that prices will not be attractive to small producers—prices will probably decline when production is shifted to mechanized plantations. If small farmers are to be incorporated as viable participants in industrial/commercial production, a greater infrastructure (extension service, credit administration, small-scale processing facilities, and subsidized transportation) will be required. Scale of technology and source of supply will have a strong impact on small producers. Whether this impact is positive or negative will depend on government emphasis. Should CIAT attempt to influence governments to protect the welfare of small farmers? Is it the right of the international Centers to choose those who may benefit from their technology?

Conclusions

It is clear that the International Centers for Agricultural Research have made outstanding contributions toward world food production. Development of more productive plant varieties has been hastened. The Centers have facilitated national efforts in developing countries for research, and drawn prominent attention to the need for trained personnel. Location of the Centers, largely in the warm climate regions, has served to broaden scientific knowledge—especially in soils and plant-environmental interactions. The Centers appear to have been effective in executing their mandate to assist national efforts which aim to effect increased output of food and livestock products, and improve the quality of life of people in developing countries.

The CGIAR is to be commended for seeking wide donor. involvement, for allowing freedom of action by the Centers in design and execution of programs, and for providing leadership toward greater commitment on the part of the developed countries to solving problems in the developing countries.

Can the effectiveness of Center activities by improved, particularly towards subsistence agriculture? Whether this can be done with the Centers remaining politically neutral will be of concern. Is the primary role of the Centers to expand the horizons of science (leaving the details of the application of their results to others), or are they also in the "developing business?" High involvement in the latter is recommended only when assistance is sought by governments—otherwise the Centers may be seriously compromised.

A feasible goal would be for the Centers to devote attention to insuring feedback from farmers. This could be accomplished in several ways: earlier and more frequent testing on farms (even at the risk of criticism for failures); routine visits by scientists to farms; establishment of close affiliation with national organizations that work directly on farms; or adoption of the model employed by ILCA, whereby multidisciplinary teams of five or more disciplines go into the field and work directly with farmers for a holistic view of farmer decision-making.

The Centers and their researchers should not be held entirely accountable for the shortcomings in their technology—it is the systems which are deficient, Training for the researchers who are good scientists for the Centers usually does not provide them with an awareness of small farm systems. Furthermore, researchers do not generally consider it their responsibility to test for acceptance by small farmers.

Country planners in the Center target countries often emphasize technology for cash crops, thereby accentuating the role of large farms in their agricultural development strategy. Universities, and other institutions responsible for training, frequently follow the "western model" of specialized farming oriented toward a single-enterprise commodity. Research on small farm systems has not been considered a "political necessity" in developing countries because of little voice in the national scene. By and large, government agencies are not organized for an interdisciplinary systems approach. There are few organizational structures of infrastructures for feedback in the systems to communicate with small farmers. Barriers to integrating research from Centers into farming systems are more fully discussed by McDowell and Hildebrand (1980).

The CGIAR has recognized the need for closer attention to relevancy to farm situations through support of the International Service for National

Agricultural Research (ISNAR), whose mandate is to evaluate methods of technology transfer.

With the CGIAR system representing a broad scope of interested, parties to development, it cannot afford to be unresponsive; therefore, it behooves those of us concerned with small farm development to take an objective approach to advising the International Centers.

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ROLE, POTENTIAL, AND PROBLEMS OF FARMING SYSTEMS RESEARCH AND EXTENSION: DEVELOPING COUNTRIES VS. UNITED STATES

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In the Farming Systems approach, it is not possible to separate research from extension; hence, extension has been added to the original title of this paper. The two components of the Farming Systems approach cannot be separated for the following reasons:

1. Farming Systems Research (FSR) is applied research,
2. without an intimate extension connection, applied research is not effective, and
3. in the Farming Systems approach with heavy emphasis in on-farm research, research is extension and extension is research.

There are those who may argue that upstream FSR (Gilbert, Norman, and Winch, 1980) is exempt from this connection. But, this implies a separation of upstream from downstream research. Contrary to what the names imply, upstream FSR flows from downstream FSR, receives its orientation from it, and supports it. Hence, it is really part of the same thing.

The Role of Farming Systems Research/Extension

The most productive role of Farming Systems Research/Extension (FSR/E) is to help improve the agricultural well-being of small-scale family farmers as they, themselves, define the concept of well-being. Agricultural well-being is distinct from health, nutrition, or educational well-being. The bias is intentional and probably will not create much animosity from those in this audience or from others who might read these words. Those who are interested in FSR/E are predominately interested in agriculture. Nutrition, health, and education are not excluded from our interests, but we are not predominately nutritionists, medical doctors, or educators.

The small-scale family farm provides the focus for FSR/E, not because the approach should be restricted to this type of farm, but because comparative advantage is here rather than with large-scale, commercial farms. The latter respond to conventional research and extension—they are business-oriented, they have full-time managers, and they have the political and economic status to make their needs known to the research/extension establishment. Furthermore, research stations much more closely resemble large-scale, commercial farms than small-scale, family farms. It is reasonable that technology generated under experiment station conditions is more appropriate to large-scale farmers.

Although much research is purported to be scale neutral (see, for example, Carter, Cochrane, Day, Powers, and Tweeten, 1981), a large proportion is not applicable to the conditions found on small-scale, family farms—for example, a corn cultivar developed and selected under irrigation with high levels of fertility, protected by pesticides, and harvested at physiological maturity to be machine dried. These conditions are frequently found on large-scale,

commercial farms. It is true that the cultivar will perform equally well in a large field as in a small field if all these conditions are met on both fields; however, on most small farms, corn suffers from no irrigation, little fertilization, uncontrolled insect and disease damage, and competition from weeds, from having been planted at the wrong time, and from having to stand in the field subject to bird, insect, and disease attacks until there is time to harvest. In other words, the small farm differs from the large farm in more than size alone.

Conventional research fails to consider the importance of many of these constraints faced by small family farmers. This is where the Farming Systems approach has made an impact.

Although the family farm is, and must be, a business, it is first a home, a source of food, and a way of life. Family farm managers (more usually, husband and wife co-managers) are not only frequently part-time managers, but also must be concerned with much more than the biological and economic aspects of the farm as an entity. The sanctity of the farm as a home makes the family farm manager much more risk averse, particularly with respect to credit, than the manager of a strictly commercial operation. A source of off-farm income to assure cash-flow may be a necessity. Being a part-time manager means that decisions are not always made, and actions taken, expeditiously. Being small means that sources of labor, markets, and information are restricted. Requirements of the manager’s and operator’s time for family affairs means that low-management, flexible enterprises are more attractive than high-level technology with rigid time schedules. We all "know" these things, but too often we ignore them.

Working in the Farming Systems approach with a multidisciplinary team makes it less comfortable and less possible to ignore those aspects of the family farm not directly related to our own disciplines. Left to their own devices, an entomologist will see insects as the main problem on a small farm; a plant breeder, a disease resistant variety as the major need; and an economist, a more optimum allocation of inputs as the major solution. Get them together with an anthropologist, and force them to look for the single most pressing problem, and chances are it will be completely different from any of the individual conclusions.

With its use of multidisciplinary teams, receiving their orientation from a first-hand understanding of the clients' situations and searching for solutions under these same conditions, the Farming Systems approach is more appropriate for working with small-scale, family farms than the conventional research/extension establishment that labors in disciplinary isolation, with an orientation dictated by the discipline and whose methodology requires strict control to meet disciplinary requirements for publication.

The primary role of an FSR/E program, then, is to help small-scale family farmers search for solutions to their problems. Within this scope, there are two levels of operation: (.a) on-farm solutions that take policy and infrastructure as constraints, fixed in the short-run, and (b) solutions involving changes in policy and infrastructure. The first level involves the FSR/E practitioner, directly, in a search for technology via technology generation or adaptation and validation of existing technology. Later, he promotes the technology found to be acceptable to the clients. The second level is indirect. The FSR/E practitioner can serve as an important source of information and orientation for national agricultural policy decision-makers and can inform them of the need for, and potential effect of, certain classes of infrastructure (Hildebrand, 1980). It is the direct application of the Farming Systems approach (on-farm solutions that take policy and infrastructure as

fixed) that will be addressed in the remainder of this paper.

Potential of Farming Systems Research/Extension

What is the potential of the Farming Systems approach for accomplishing its role as a purveyor of solutions to the problems of small-scale, family farms which operate in an environment that encourages large-scale, commercial and specialized farm firms and discourages small-scale operations? If compared to conventional research and extension, and measured in terms of technology adopted by small-scale, family farmers, the Farming Systems approach will have to be found both cost and time efficient. Unfortunately, it will be very difficult to measure these criteria because (a) few FSR/E programs have been in existence sufficiently long to be able to detect changes in technology adoption, and (b) even where changes can be detected, there is no adequate control group generally available against which to measure the difference between an FSR/E program and conventional research and extension.

The FSR/E program at the Institute of Agricultural Science and Technology (ICTA), in Guatemala, has been working in some areas of the country since 1974, and some progress in technology adoption by small-scale, family farmers is measurable (Hildebrand, 1979); however, no control area is available. The ICTA is the only research institute in the country charged specifically with technology generation (National University also conducts research, but it is largely academic in nature), so where ICTA is not active, virtually no research is operative. On the other hand, ICTA was created because the conventional research and extension entities existing at the time were not affecting small-scale, family farmers, who produce the majority of the basic grains in the country (Waugh, 1975). One should be able to conclude that if progress is now being made, the FSR/E approach developed and practiced by ICTA must be at least partly responsible.

The potential for reaching small-scale, family farmers exists because the FSR/E approach works on more holistic solutions (not in the sense of complete technological packages, but in the sense that the solutions take into consideration all the conditions on the farm) and, therefore, solutions that are more acceptable to the farmers for whom they were designed. In turn, because the solutions are acceptable, extension is easier because extensionists are not forced into the role of having to "sell" something that the client really does not want or cannot use very well.

Most important in cost and time efficiency, the FSR/E approach tends to develop technology beginning at the farmers' present level and not at some theoretical level which they "ought to be able to achieve." It may take years before sufficient modifications have been made in high level or complete package technology that farmers are willing to "give it a try," and if farmers are not willing to experiment with it, the new technology will certainly not be adopted. In its initial efforts, the Caqueza Project in Colombia, amply recorded by Zandstra, Swanberg, Zulberti, and Nestel (1979), is an example of this approach. Zandstra learned by this experience and was able to significantly improve his methods in later years at the International Rice Research Institute (IRRI).

In its earliest years, ICTA also utilized complete technological packages, but soon learned that small-scale, family farmers reject such complicated changes (Hildebrand, 1979). As the number of components in the package was decreased from eight to two, acceptability and adoption increased significantly. Other examples could be cited to show that small farmers are much more apt to

experiment with and adopt simple changes than complex ones.

In the life of most agricultural development projects, with evaluations or change of personnel every two years, a wait of five or more years to see results is expecting too much. Conventional research and extension projects may well suffer from this delay before seeing any effect if adaption by small-scale, family farmers is a criterion. Most probably, the project will be terminated before that time for lack of measurable results. The potential of the FSR/E approach is to shorten the time between project initiation and the utilization of the technology by small-scale, family farmers.

Problems with Farming Systems Research/Extension

There are four primary problem areas associated with an FSR/E program:

1. professional or disciplinary,
2. institutional or administrative,
3. technological, and
4. training.

Each area presents unique kinds of problems, but none are insurmountable if an institution is serious in its desire to establish a program.

Professional or Disciplinary

Disciplinary traditionalism can be more of a barrier to the adoption Of technology by small-scale family farmers than is the much maligned traditionalism of the small farmers (Hildebrand, 1981). Disciplinary tradition affects orientation of research topics, research methodology, and professional evaluation of research personnel. None of the above are immediately amenable to the kind of research required in an FSR/E program where orientation comes from an intimate knowledge of the farmers' situation; methodology suffers from a lack of precision and thoroughness, plus a need for urgency and practicality; and evaluation for promotion, tenure, and/or recognition is hampered by a shortage of books, bulletins, or articles in professional journals which have not been written because the FSR/E practitioner spends too much time in the field.

The tradition of academic freedom and individualism in many professions hinders participation in team efforts, Persons tend to think, "What interests me?" instead of "What can I do to improve the product of the team?" An overriding concern with self-interest impairs contribution to a team and has a negative effect on team effort. Self-interest is justified by these individuals on the grounds of professional evaluation, but it can as often be triggered by the comfort of working without pressure within the confines of one's own discipline.

Institutional or Administrative

A number of institutional or administrative problems must be overcome for an FSR/E program to be effective. Organizational flexibility (Shaner, Philipp, and Schmehl, 1981) is a necessary condition. In the first place, research and extension are separate entities, or separated parts of a common entity, in most situations. Many times, they do not work well together, and petty jealousies are not uncommon. In countries where both groups exist, it is probably optimum for some from each to come together to form an FSR/E team, however, this may

also be the most difficult to achieve. More probably, one group will initiate FSR/E efforts, to be joined later by the other. In the Guatemalan case, ICTA, the research group, initiated FSR/E efforts, and, little by little, extension has been joining in. Another alternative is for a new group to initiate FSR/E efforts. At the University of Florida, new personnel with joint research/ extension appointments are gradually pulling both research and extension personnel into the FSR/E program in the northern part of the state.

Personnel appointments can be a problem in departmentalized organizations because of the multidisciplinary nature of FSR/E. At the University of Florida, it took a year to formulate hiring procedures when a specific departmental affiliation is not predetermined—the procedure is now operative. To alleviate problems with personnel evaluation, FSR/E personnel at Florida have joint appointments heavier in extension than research, So there is less pressure on professional publication and more on farmer contact and technology adoption.

Logistical support can present special problems because of the multi-departmental nature of a FSR/E program and because much of its work is located on farms and not on experiment stations. Flexibility in making purchases and sales must be created because farmers will not understand bureaucratic delays in planting or harvesting crops. Transportation is always a difficult item to obtain, but must be available to an FSR/E team. Fortunately, the additional expenditures in transportation are offset by reduced expenditures on experiment stations.

Technical

Technical problems in an FSR/E program exist because of the location of most trials on farms and in uncontrolled conditions. Experimental design and the analysis and evaluation of results of farm trials are different than for experiments on stations. A regional response with a high level of variance or experimental error is of more value than a single site response with great precision. Intuition and lay (farmers') opinion become as important as statistical analysis. New methods have been required and are being developed (see, for example, Zandstra, 1979 and CIMMYT, 1980).

Training

A final problem is the training of FSR/E teams. All individuals on the team must be instilled with multidisciplinary tolerance. That is, they must have some knowledge of the fields of the other persons on the team; be able to contribute to the other fields; and be able to accept contributions from those in other fields. Agronomists must know how to interview farmers, and anthropologists must understand how to set up, plant, harvest, and analyze data from field trials. They should be willing to work with each other in these tasks when needed for effective team effort.

Training programs do exist. The ICTA, in Guatemala, has an effective national level training program, but it is almost exclusively for agronomists (ICTA, 1978). The International Maize and Wheat Improvement Center (CIMMYT), in Mexico, has an excellent multidisciplinary training course, one example of which is underway in Venezuela at the present time. At the International Potato Center (CIP), in Lima, Peru, social scientists train agricultural researchers in "investigative and analytic techniques useful for linking agricultural research more closely to farmer needs and farm-level conditions" (Werge, 1978). Cornell University, CIMMYT, and The Rockefeller Foundation

experimented with a successful multidisciplinary training program at the Ph.D. level (Contreras, Galt, Muchena, Nor, Peairs, and Rodriguez, 1977), but, to my knowledge, it has not been repeated. The IRRI Cropping Systems Network in Asia has been responsible for the training of many FSR/E practitioners. The University of Florida has initiated an FSR/E training program with both degree and non-degree status.

Training multidisciplinary teams does not imply making generalists of the members. On the contrary, a multidisciplinary team is much more effective if each member is well-trained in his own field. The agronomist must be a good agronomist and anthropologist, a good anthropologist. But, they must be stretched out of the narrow confines that traditional training reinforces. The University of Florida does not offer a degree in "Farming Systems," rather, it offers a "Farming Systems Minor" for any agriculturally-related Master's or Ph.D. degree. All graduate advisors, however, are not willing to let their students take a multidisciplinary minor, just as some students resist taking courses out of their major field. The Farming Systems approach, obviously, is not for them. But, there is still a big demand from students who feel the need to have some demonstrated practical application of their otherwise theoretical curricula.

Developing Countries Versus the United States

The role, potential, and problems of FSR/E in the United States are very similar to what they are in developing countries. Experience in establishing FSR/E programs in different developing countries has shown that each country and each institution requires a somewhat different approach and presents distinct challenges. However, the situation faced by small-scale, family farmers is surprisingly similar in most countries, including the United States. Compared with Guatemala, north Florida has a limited number of small farmers, but they have little voice in public affairs in either location. In north Florida, the small-scale, family farmers have limited access to some markets; they predominately utilize family labor; a significant part of their subsistence comes from the farm; many have little contact with the extension service; intercropping is still practiced by some; and the farms are highly diversified and the farmers very conservative regarding new practices and the utilization of credit. The same is true of small farmers the world over.

The greatest difference—and the tremendous advantage which the United States offers an FSR/E program—is the availability of professional expertise. The college of agriculture in a U.S. land-grant university has a formidable array of expertise, laboratories, and equipment that can help solve the problems of small-scale, family farmers. Except, perhaps, for a limited and fortunate few, entire developing countries cannot match this potential. However, in the United States, most of this potential is fully employed in tasks other than those important to the small farmer directly. So it is not necessarily available to service the needs of a domestic FSR/E program any more than it is all available to service the international programs of the U.S. universities in developing countries.

In summary, after fifteen years of working to create multidisciplinary programs in an array of institutions in developing countries, the author anticipated relative ease in establishing an FSR/E program in a U.S. land-grant university. Alas, the illusion was soon shattered. Virtually all the same kinds of problems existed as had been encountered in all the other countries. Nevertheless, after a delicate conception and a stormy gestation, the baby has been born and is making its presence felt. It still falls from its makeshift

crib from time to time and occasionally get its knuckles rapped, but it does have five full-time positions, an adequate budget, an appropriate clientele, and, finally, general peer support. In retrospect, there is not that much difference in the role, potential, and problems of an FSR/E program in the United States and in developing countries.

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SESSION III PANEL REMARKS

Charles Deyoe, Head, Department of Grain Science and Industry, and Director, Food and Feed Grain Institute, Kansas State University, Manhattan, KS:

Having been out of town all week and getting back last night, I haven't had an opportunity to take advantage of the opportunity of listening to the previous speakers or hearing other presentations that occurred. In the presentations this morning, however, a point that I would note would be that Dr. Smith, in his review, indicated the fact that technology development, as far as the United States is concerned, is generally slow, and often, perhaps, comes in its own time. At times, it may involve the rediscovery of existing information that occurred at a more appropriate time. In my own field, I can recall where technology cycled, or was rediscovered, two or three times before it found the right application. So I just want to say that while technology, is developed, there are many factors that are involved in seeing it adopted and applied, particularly to the farming systems—small farms or large farms. Adoption may also be related to, and dependent on, the appropriate resources—these may be human, economic, etc.—or other developments that bring into focus the relationships that may be involved in the technology that is developed. It may require a stimulus or pressure, such as government programs, economic incentives, or other types of things. Finally, the point was made that priority setting is one of the most important things in looking at the development of technology and also its adoption—with the charge that, first things first, thorough studies be achieved and then related policy formulated.

The next speaker (McDowell) reviewed, in a very thorough manner, the achievements in, and activities of, the International Centers and the charges that they have to be the center of technology development. He indicated that the policy direction may often start at the top, or be at a higher level, and not necessarily be directed to the farmer; but the direction may be that of developing an appropriate technology with the hope that it will filter down, and that it will benefit all of those in the system.

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One of the things I noted in his paper, was that, generally speaking, the evaluation of the quality of the product is not a major focus, but occurs only if it affects productivity.

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Trade-off values were discussed and particularly related to the animal involvement in food production and the fact that the higher productivity crop production may not always be the most suitable for adoption in a country, particularly when food for animals is involved—when it's a trade-off between higher yield and reduced food production.

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I was interested in the comment, and I think all of us would agree, that multidisciplinary work is easy to talk about, but very difficult to achieve. In our own programs here at Kansas State, I think we see these developments and difficulties many times.

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The goal of the small farming systems approach to improve the welfare of the farmer certainly identifies that, rather than applying perhaps the latest technology in all areas, we should identify the full system and the farm family

and their needs as we look at the goals and the application of technology to help achieve those goals.

When we talk about the fact that a small farming system takes time—and it takes a considerable length of time to see progress in it—I can relate to that; but I also feel that it's not so much different from a plant geneticist who undertakes the goal of achieving a new plant variety—he doesn't see his result in two years or three years either, he may spend fifteen or twenty years in developing that new technology...the adoption and application he is looking for.

* * *

How can we in the university community, as professionals, look at methods of applying what we know and what we can do to help the small farmer and the farmers in other countries. One of the problems that I see in my role as the department head is how to undertake the peer evaluation system that we undergo in much of our institution. This is a very difficult problem—to see rewards, professional advancement, professional achievement. The professional involved in international development does not have the publications or manuscripts, many times, that are required in our traditional system of peer evaluation. Many of our colleagues in other areas do not understand these goals (in international development work), and the scientist's most severe critic may be another scientist. So I see this as a rather complicated problem to look at as we look at people dedicated in these areas, complicated from the standpoint that those people should expect to see advancement in professional fields the same as others. The documentation to support what they've achieved is much more difficult to assemble and to support.

Also, one of the things that I note, and I think about considerably as I look at activities and programs in which we have a group of scientists that apply their set of skills internationally, is that we heed to have a clearer identification of the administration's support of these programs. Now I'm not talking about administrative support for our programs at Kansas State necessarily at the level of the department head and the college administration in agriculture, but I'm talking about administrative support from higher levels—support by the Board of Regents of the goals of the university in programs of this nature; it is the legislature in the state that appropriates the money that keeps the universities running and appropriates the salaries of the scientists involved. Do they understand the missions and the goals, and are they supportive? I think that's a very pertinent question, very important. Does the governor of the state support those directions and those goals...?

Jan Flora, Department of Sociology, Anthropology, and Social Work, Kansas State University, Manhattan, KS:

The papers in this session each shed different light on appropriate technology development and delivery to small farmers. Hildebrand examines mechanisms at the level of the small farmer and linkage to the national research/extension systems. McDowell looks at the capacity of the International Centers to generate appropriate technology and at the Centers' ties to the national agricultural research systems. Smith examines the question, "What can be learned by Third World countries from the U.S. historic experience—specifically in the area of dryland farming?" He implicitly raises the question of whether FSR can handle certain researcher-induced innovations for which no felt need exists on the part of small farmers.

I would like to deal with selected issues raised by the papers, drawing out the implications of what is said in a particular paper and linking points

from one paper to another:

1. The main conclusion of McDowell's paper (although not explicitly stated as such) is that the major constraint to the ICAR's attempt to do effective FSR (which Hildebrand points out is inherently oriented toward peasants or small farmers) is political; there is a need to develop a constituency for such research. That objective is obfuscated for a number of reasons: the interests of scientists from developed countries in research which is complementary to the commercially-oriented research that they do in their own countries; concern among ICAR scientists for increasing production with distributional effects tagged on as an afterthought; lack of political power among small farmers in developing countries; and the touchy issue of the International Centers having on-the-ground involvement with peasants in developing countries and thereby invading the territory of the national research centers. McDowell concludes by asking, "Can the International Centers assist subsistence agriculture and remain politically neutral?" Although his paper is ambiguous in answering the question, the answer would seem to be "No," since, in both developed and developing countries, policies favor large commercial agriculture.

   The example of the International Center for Tropical Agriculture (CIAT) illustrates my conclusion. The CIAT's most successful program, as measured by implementation, is its rice program (conducted in collaboration with IRRI) as adopted in Colombia. Colombia, using IRRI-CIAT varieties, is self-sufficient in rice and has one of the highest yields in Latin America. This is due to the availability of appropriate high-yielding varieties and to a favorable institutional structure in Colombia. FEDEARROZ, the commodity organization of medium and large-scale Colombian rice producers, facilitated adoption of the technological package through its technical department, which grew from one agricultural technician in 1961 to eighty in 1970. FEDEARROZ also provided inputs to its members at below commercial prices (taking advantage of favorable exchange rates). Once production had expanded sufficiently, an export subsidy cushioned declining internal prices. Also, IDEMA (the state food crop marketing agency) increased its purchases of rice from less than 2.5% of the crop to around 10% so that internal prices generally exceeded international market prices in the 1970s (OFISEL, 1979).

   The only significant success in CIAT's cassava program is Thailand, which has increased cassava production for livestock feed for export to Europe. Cassava chips, unlike more conventional livestock feeds, have no import duty imposed by the EEC; thus, even a small farmer food crop has experienced its greatest success in the commercial industrial arena.

   Hildebrand indirectly mentions the political aspect of FSR. He says the FSR program's role is to help small farmers search for solutions to their problems, by both (a) on-farm solutions that take policy and infrastructure as constraints and (b) developing expertise on how those constraints should be changed. He does not examine the political strategies necessary to change policy in order to ease those constraints. Maybe that will be his next paper. It should draw from Uphoff's paper of the previous session, for the technical expertise must be complemented with political participation by peasants and small farmers in whose interests such policies should be developed. They are an essential constituency for FSR.

2. Hildebrand's paper is best discussed in terms of Dr. Price's paper presented in the previous session. Price suggests two reasons for on-farm testing: (a) it duplicates the ecological conditions under which a group of peasants operate much better than does an experimental plot and (b) it develops a knowledge of the resources available to small farmers, including labor and traction power in peak and slack periods, capital availability, technology presently in use, and institutional constraints. Price goes on to say that an innovation "fits" if it (a) produces more food and (b) is accepted by farmers. However, he says, since farmer acceptance cannot be measured under the conditions in which IRRI's farming systems program operates, "whether or not the pattern is more profitable than present technology is taken as the test criteria."

   Hildebrand goes a step further. He says farmer adoption is the criterion for success of a new technique. Hildebrand's approach is much more radical, since it assumes that the peasant is the best judge of what is in his/her own interest. It may be that that leap of faith must be taken, otherwise FSR is too expensive. New innovations in commercial agriculture are widely applicable because commercial agriculture changes and standardizes the local ecology; peasant and small farmer agriculture adapt to the local ecology. Hence, each innovation in FSR will be much less widely applicable than is true for an innovation in commercial agriculture. In the main, there may be no choice in FSR but to rely on the peasant's judgement.

3. Dr. Smith emphasizes the technological over the political and social aspects of innovation. He argues that, historically, there has been a lag between development of knowledge and actual application of new agricultural technology in the United States, He states. "The state-of-the-art in today's developing countries is not so advanced as that of U.S. farmers seventy years ago." However, he modifies that statement with an example from the Philippines: farmers use advanced rice production methods, but corn production is at a low level because of poor cultural practices and lack of modern inputs. In his paper, Price provides a clue as to why this occurs—rice is the main crop; corn and legumes must fit around the optimum growing season for rice. In order to understand why corn is broadcast, rather than planted in neat rows, it would be necessary to examine seasonal labor requirements of the family, the level of risk for the off-season crop, and other factors; in short, FSR would be an appropriate methodology for examining why techniques used in rice production are superior to those in corn production.

   Smith recognizes the difficulties, if not the dangers, of pushing modern inputs onto peasant farmers. Although he sees that, ultimately, fertilizers, improved crop varieties, and machinery would be beneficial, he recommends reduction of seeding rates as a first step in improving disposable production. This is not a farming systems approach. It is not likely that Hildebrand's sondeo (sounding) method would uncover excessive seeding rate as a concern of peasant farmers. This raises an important question. Is there a place for researcher-induced innovation in FSR? If so, how might it be incorporated into the FSR approach?

(Reference: Balcazar, et al, "Cambio tecnico en la produccion de arroz en Colombia, 1950-1979," Documento PROTAAL No. 41, lnstituto Interamericana de Ciencias Agricolas, Bogota, Colombia, julio de 1980.)

Hugh Popenoe, Director, International Programs, University of Florida, Gainesville, FL:

Dr. Smith emphasized the importance of time and political continuity in technology transfer, which I think was an excellent point. Equal weight should be given to the importance of policies in the transfer of technology, such as pricing policies, credit, and other national or institutional constraints.

Many of you are familiar with the King of Siam's comments in the musical by the same name, "is a puzzlement." I am glad the issue of corn came up, because corn "is a puzzlement." We probably know more about corn breeding than almost any other basic commodity and have developed more research in that area; yet today, the average corn production in Latin America is the same as when Columbus first arrived. And corn, I'll also point out, is one of the first commodity groups that was addressed by the International Agricultural Research Centers through CIMMYT. But the problem with tropical corn has not been a problem so much of the research available, but the application of that research. Next year there will be an international conference by the major corn breeders to try to identify the important constraints to increased production. This has been one of the sticky wickets in the area of technology transfer—why, for instance, can't we grow corn as—well in its original home in Central America as we can in Kansas?

One of the major constraints on the use of seed varieties in the developing countries that really wasn't touched on in Dr. Smith's paper—but one of which many of you are quite aware—is that once these varieties are developed, the infrastructure oftentimes does not exist to produce large quantities of improved seed or certified seed, and distribute it. This is one of the problems, of course, that happened with the use of hybrid corn. In developing countries, the farmer does not want to buy new corn seed each year—he wants to be able to use his old corn seed, which doesn't work. I would argue that we should also emphasize the necessary infrastructure to help us implement the use of improved varieties.

Dr. McDowell gave a very good review of the International Centers and, I felt, a fairly frank and just appraisal of some of their deficiencies. He did mention the problem of insulating the International Centers from politics, a matter of paramount importance. He also mentioned the fact that there have been some problems with board membership. One result of the new five year review is to try to make the membership of the boards of various International Centers more representative of areas of technical expertise rather than institutions or governments.

McDowell also mentioned the need for improved relationships between universities and the International Centers, which has been of considerable concern. As many of you who are familiar with the Title XII legislation know, one of the mandates of that legislation is that the U.S. universities become more involved in the Centers. A proposal has been presented to the Centers by the Joint Research Committee of Title XII, which attempts to reinforce those linkages with outside funding. Under this plan, faculty members and graduate students will have more opportunity to work at the Centers, and the U.S. universities will have more opportunities to do basic research which backstops the Centers in their more applied approaches.

Dr. Hildebrand did not say much about the need for infrastructure to help the small farmer. Many of the constraints in small farm systems are in marketing and credit. Through the small farm systems approach, these constraints should be analyzed. Often they are ignored when one is focusing on the small farmer himself and studying the ecological and biological constraints rather

than some of the institutional constraints. This approach is implicit in the methodology, but too often overlooked.

One of the points that the previous discussants made indirectly pertained to the cost effectiveness of the farming systems approach, and Dr. Hildebrand mentioned this in his paper when he said, "We're not really looking at economic returns in many cases, but whether this practice is desired by the farmer." I remember several cases in Latin America, in my own experience, where I had paid people to do particular tasks and found that they had been accomplished with Herculean strength—not to get more money, but to be able to quit two hours earlier and have more leisure time. Also, there are other incentives, and I think Dr. Hildebrand correctly addressed those. But, the point is well made in terms of cost effectiveness of the farming systems approach. We are often talking to the bankers—the political institutions, congressmen, the World Bank, AID, and others to whom this is an investment opportunity. It is difficult to argue the cost effectiveness of the small farm systems approach when five researchers are working on a single farm. Of course, this underscores the need to develop typologies of those systems so that the particular farm being studied is very typical of a certain group. We should also argue for the investment opportunities in terms of social and other returns, as well as economic returns.

The final point to be made on all three papers is that one of the important underlying features of these programs—whether we're dealing with transfer of technology, the programs of International Centers, or really allowing, the farming systems research/extension program to have a fair, full trial-is to provide continuity of effort over a period of time. Too often, in many countries, programs are looking at the short-range, immediate benefits. By starting many of these programs and shutting them down two or three years later, we have self-fulfilling prophecies that indeed they never would have worked—this can be one danger, I remember the comments made by Dr. Raymond Crist after he had been working in Latin America for a long time. He had seen many technical assistance programs come and go. Each year agencies had a new motto—whether it was "village level approach," the "poorest of the poor," or the "trickle down technique." In that particular year, the motto was "impact programs," and he said, "I just don't know how many more impacts these Latin Americans are going to be able to take." I think this is symptomatic of the fact that we do need to consistently emphasize that many of these programs are not immediate solutions, but need a long time for development and fine tuning.

Serrano Segundo, Regional Director, Ministry of Agriculture, Philippines:

...Dr. Hildebrand said that the FSR/E linkage is born, but it is, perhaps, something else as to how long it will take to really work for the small farmer. You see, for the small farmer, the waiting has been long, and many of the pessimists are discussing whether or not to farm...

The truth of the matter is that, in many developing countries, small farmers remain contented with the life that they have—working hard—and with what they have. Farming systems research will take time to improve the small farmer's present situation... As pointed out, it took time to develop the specific technologies for the farmers of the United States; and it took an even longer time to deliver the appropriate and acceptable technology to increase the productivity and income of the farms.

* * *

It was stated that the potential of FSR/E is based on the holistic, multi-

disciplinary approach planned with, and therefore accepted by, the farmer; it will still be dependent on professional teamwork... In order to effect teamwork, there is the indispensability of training for multidisciplinary capability and complementation.

The research/extension linkage continuum is the model which we hope to prove workable for the small farmer.

* * *

John Dunbar, Dean, College of Agriculture, and Director, Agricultural Experiment Station, Kansas State University, Manhattan, KS:

...The goal of increased food production must be met—there's no question. It has to be profitable on a sustainable basis for the farmer. I don't care whether the farmer is in Bangladesh or the Philippines or Western Kansas, the problem is universal. And the complex things that you've talked about are all true.

* * *

We have moved ahead. I think this is one of the things that is terribly important, that we go back and think...10...20...30...40...50...60 years ago, the tremendous development that has taken place. There is a lot of hope, there is a lot of previous progress, and it has all taken place one little step at a time in individual farmers' minds whenever they have improved their productivity so that they've improved their income, so they could feed their families.

...People are interested in improving themselves...

The end result is to take that farmer where he is, however you want to describe it, and get him to make one little step at a time. How many of you learned your multiplication tables? Put up your hands. Most of you—some of you didn't. How did you learn them? One times one equals one...one times two equals two. How many of you got your Ph.D.? How did you learn all of the things that you know? You sweated over each one of them, didn't you? How many of you would change your ideas very much? We're dealing with human beings just like us. And so, I guess what I'm really saying is we don't dare get in too big of a hurry.

* * *

SESSION III QUESTIONS

Question directed to Floyd Smith:

How would you set up priorities? Wouldn't they vary from place to place, level to level? What criteria would you follow?

Response :

Order of priorities certainly will vary from place to place depending on a variety of factors, for example, economic situation, state-of-the-arts relating to agriculture, technical knowledge and associated capability, etc. Furthermore, there are not always precise separations among the several choices, but, considering what is available in the way of knowledge about a specific developing country, it should be easy to assign priorities relating to cropping systems research vs. soil testing research vs. sophisticated training in analytical chemistry vs. training in physical chemistry.

Comment directed to David Norman by lvonne Audirac, Sociology Department, Colorado State University, Fort Collins, CO:

The accepted rationale for helping small farmers all over the world, and particularly in the Third World, is that increasing population growth means more mouths to feed and, thus, all research efforts and meetings of this kind are aimed at developing "scientifically" legitimized formulas to attend to this problem. My comment is that a major issue has not been raised and that increasing agricultural production does not necessarily mean that such food, if actually produced, will reach those hungry stomach—especially when traditional agricultural development efforts have been focused on making a subsistence farmer a commercial farmer and, most desirably, an exporter of mostly cash crops consumed by center or developed countries.

Response :

I agree that what you have said has in fact often been the case. However, in principle, the FSR approach can be used to further such an objective or to pursue an alternative objective such as increasing food self-sufficiency. Unfortunately, FSR by itself can do little to help those who don't have the land and other resources to produce products. People who can't produce an income can't consume. In such cases, large institutional changes may be necessary, such as land reform.

Question directed to Robert McDowell:

Given that the lab for the social scientist is the human environment beyond the research station, and given the constraints on the International Research Centers to stay politically neutral and isolated from the country citizenry, what is the realistic potential for FSR that is truly multidisciplinary at the International Centers?

Response :

Given the constraints of the charters of the International Centers in that they must work through national agencies, the conduct of FSR as a multidisciplinary approach will require time to develop. This is because the traditional organizations of the ministries of agriculture or livestock do not

usually include social scientists. This limitation has been recognized by the CGIAR and led to the development of the International Service for National Agricultural Research (ISNAR) in 1980. The ISNAR's mission is to assist governments in strengthening their national agricultural research capabilities. The other centers will likewise be working toward getting governments to recognize the need for a more holistic approach to agricultural research.

The International Livestock Centre for Africa (ILCA) has multidisciplinary teams (which include one or more social scientists) working in Mali, Nigeria, Botswana, Kenya, and Ethiopia. The social scientists have contributed a great deal in helping to identify constraints to livestock production. The findings by the social science disciplines have been quite important in selecting the technology to introduce to farms. The acceptance of the recommendation by ILCA—that national organizations include social science components in their agricultural research programs—has received limited acceptance, mainly due to the fact that the livestock ministry consists almost entirely of the traditional disciplines. ILCA is in the process of developing several publications on methodology for FSR to serve as a guideline for governmental organizations and, at the same time, strengthen the case for need of a social science component. IRRI, CIAT, CIP, and ICRISAT have now included social scientists in their field teams, but results are limited at this time to make projections on how successful the team approach can be used to assist governments.

Question directed to Peter Hildebrand:

We often claim that our research is independent of farm size. You submitted that much of our research is in fact dependent on farm size. We also claim that our research is apolitical. Are we being naive there also?

Response :

Only indirectly, as our research benefits certain economic classes.

Question directed to Peter Hildebrand:

Research effort implies failures along with hoped for successes. Do small farmers have sufficient reserves to withstand reverses, or can they only support successful research—which is no research at all?

Response :

Exploratory research should be conducted on experiment stations or rented farm land. Only when sufficient screening has been achieved to assure a minimum of risk should the farmer be involved. Complex technology or technological changes, therefore, will require more lead time than simple changes, many of which can be installed immediately on small farms.

Question directed to Peter Hildebrand:

If the most productive role of FSR/E is the well-being of the small-scale family member, why are there no nutritionists, health workers, and educators in the whole system that must be considered?

Response :

All of these fields could play an important role in improving the small farm family's welfare, however, most organizations are organized around one or the other of these fields so their incorporation would involve additional integrative efforts. I feel that it is probably better to begin as simply as possible, so undertaking the task of modifying agricultural technology is about as complex a problem as most organizations can handle.

Question directed to Peter Hildebrand:

How can we evaluate on-farm research if we can't control or document the technology actually used?

Response :

The technology actually used must be documented through farm enterprise records, but it should not, and need not, be controlled. New technologies being tested must be evaluated on a regional basis with all the good and bad that farmers will give it if, and when, adopted; hence, it must be evaluated against the non-controlled actual farm practices. Means and standard deviations can be used effectively to evaluate yields, income, and stability of the technologies.

Question directed to Peter Hildebrand:

Much verbal support has been given to the role of women in agricultural production in the developing countries, but little has been done to operationalize that understanding, reflecting yet another arena of lag. Can you give any leadership ideas to your male colleagues to help them conceptualize in their thinking, rather than the farmer "he," the adult partnership farms using the farm partners "they," such as might be conceptualized regarding two single adult brothers who team up to run the family farm after the death of their parents? Would not the implications for interventions be different if one understood that one of the brothers was kept with ears plugged up, blinded, hog-tied, and...pregnant? Of course this problem is exascerbated when the unshackled brother goes off to war, the mines, or the nearest big city.

Response :

One of the best ways to assure that the multidisciplinary team takes women into consideration is for at least one of the team members to be a woman.

Question directed to Peter Hildebrand by David Schroder Department of Agricultural Economics, University of Missouri, Columbia, MO:

The FSR approach, as we have conceptualized it in Missouri, is not a new phenomenum. This approach was initiated early in this century by Mr. Doane and others in connection with some of the earliest work in extension with rural families. This approach became a focal point in Missouri extension and research programs—starting in 1940 to present. For three decades this approach was carried on under the name of "Balanced Farming," and now continues under the "Family Farm Development Program," as well as other small farm programs. I do not see a great deal of difference between what

is now being called "FSR" and what Mr. Doane, Al Hagan, and others have called "farm management."

Response :

Farm management searches for ways to reallocate resource use to improve performance on the farm with existing technologies. Farming systems research/extension searches for new technology as a means of improving performance.

Question directed to Peter Hildebrand by David Schroder, Department of Agricultural Economics, University of Missouri, Columbia, MO:

Given you have a team of individuals working together on small-farm problems, how do these individuals work with the farmer? Do all of the individuals meet with the farmer at the same time?

Response :

After the initial contact by two teem members, usually one member (but preferably two) meets with the farmer on each visit.

Comment directed to Peter Hildebrand:

Resource constraints are more pronounced with small farmers than with larger farmers. Also, technology is no substitute for good husbandry practices. I have worked and lived with low-income farmers in Costa Rica for two years. I found a great deal of their production problem are centered around, poor management. Farmers do not need herbicides to control weeds because several farmers and I had good results on local "criollo" corn varieties in increasing their production two-fold by just doing a better job of controlling weeds. Another point, I found small farmers' objectives were very similar to objectives my father had in wanting to provide a better living for the family and greater security for the future.

Response :

Most farmers know that better weeding will improve yields. It is a constraint of available labor during peak weeding periods that limits their capability to comply and not "poor management." If you helped the farmers weed during this period, you effectively removed that constraint artificially,

Question directed to Peter Hildebrand by David Schroder, Department of Agricultural Economics, University of Missouri, Columbia, MO:

Where does the role of farm-planning with respect to farmers' objectives come into play with the FSR/E approach?

Response :

Farmers' objectives are evaluated during the Sondeo and by constant farmer contact during the technology generation and promotion phases of the FSR/E approach. If farm planning is considered as a constraint, then new technology for improvement of this aspect of farming would be included in the technology generating procedure.

Question directed to Peter Hildebrand by William Jaeger, Department of Agricultural Economics, Purdue University, West Lafayette, IN:

Our discussants and speakers have asserted that what is needed is to Look closely at individual farmers; that we need to look at the household as both a consumption and a production unit; that we need to look beyond the farming system to the village system; that, in fact, we need to look at a region on nation as an integrated whole; and that we need to have a high level of participation and an interdisciplinary—or "transdisciplinary"—approach. These assertions are difficult to argue with if we assume that research is costless and that all small farmers have problems. But, if being small is not in itself a problem, and if FSR draws from the same pool of limited resources available for all types of research relevant to agricultural and rural development, then an assessment is needed of the problems faced by farmers in a particular region. Furthermore, there should be a determination and comparison of the costs of such a research effort and the potential benefits. Adoption does not imply a large benefit; increased yield may result in a worsening of the small farmer's situation. The costs of FSR have not been discussed to any great extent during the symposium, but relative to other types of research it is very costly.

My question is this, where in the FSR methodology do we provide for an assessment of the costs and potential benefits of the research and a determination of whether or not the farmer has a problem that warrants the research investment?

Response :

As I stated in my paper, if measured in terms of technology adopted by small farmers per dollar investment in research, FSR/E will surely be found to be cost effective because so little of traditional research finds its way into the hands of small farmers. Assessment of problems is initiated with the Sondeo or Rapid Appraisal and continues with the use of farm or enterprise records and because the technicians are "farming" under real farm conditions.

Question directed to John Dunbar:

Does Kansas State University have a policy with regard to small farms? What is it? How is it formulated? How is it implemented? How does this policy benefit small farmers?

Response :

Kansas State University has some extension farm management programs designed for small farms in Southeast Kansas. All extension programs are designed to assist any farmer of any size to develop the most economical combination of crop and livestock enterprise for his land and other resources, and then determine the most appropriate size of enterprise and technology for production of crops and livestock by individual crop or individual type of livestock. Research programs are mostly non-size-specific, e.g., they deal with specific items of sciences, technology, or production practices. Agricultural economics research programs develop analytical systems into which can be placed the coefficients relevant to any size or type of farm. Both the research and extension programs at KSU help small farmers optimize their crop and livestock production and make the biggest profit possible from resources available.

WRAP-UP

(Brief closing remarks by Vernon Larson.)

David Norman, Department of Economics and Agricultural Economics, Kansas State University, Manhattan, KS:

I have, in conclusion, five points that I wish to make.

1. We have very much appreciated such a large number of people attending this Symposium. I think this is a good reflection of the concern that currently exists with reference to small farms, both in the United States and in developing countries.

2. Unfortunately, we made certain assumptions about the Symposium. For example, it was assumed that most people knew the characteristics of FSR as it is currently practiced in developing countries. We apologize for making this assumption. In retrospect, it would perhaps have been better to have had the papers on FSR nearer the beginning of the program.

3. I sense there has been a certain degree of frustration amongst some of the participants at the Symposium. At times, the level of discussion seemed rather esoteric. I think there are two reasons for this: (a) most of us at this meeting are scientists and, unfortunately, it appears we have to justify our existence through being scientific; and (b) those of us working internationally are faced with a dilemma in the sense that there are very large numbers of farmers in the developing world; seemingly impersonal methodologies have to be employed in order to select and work with a few farmers that are representative of a large number of others, thereby providing a multiplier effect for the results of research work at the farm level. Because of this approach, it appears at times we may be talking down to farmers rather than interacting with farmers.

   The time spent on the scientific approach to small farm problems may have frustrated small farmers and some of the U.S. based people working on small farm programs domestically. Both groups have, on occasion during the Symposium, emphasized the advantages of one-to-one contact between, for example, the extension agent and the farmer. Obviously, this approach is simply not possible in the developing world. I don't think we can resolve the frustration that has occurred, but I sincerely hope that we keep on talking to each other.

4. One of the ideas of this Symposium was to compare and contrast small farms in developing and developed countries. We hope that arising out of this, it will be possible to show the complementarity between working with small farmers in the United States and in developing countries. This is important from three points of view: (a) it is important in terms of exploring ways of helping small farmers in both developed and developing countries to improve their welfare; (b) if such complementarity does exist, it helps U.S. scientists to make a constructive input in the developing world through helping national programs and International Centers; and (c) it helps U.S. land-grant institutions justify their international programs to both their administrators and state legislators, an issue which Dr. Deyoe raised in the discussion during the last session.

   The system has demonstrated commonality in terms of general problems of small farms in developed and developing countries. It has also demonstrated that there is not a commonality in terms of approaches used for

looking at and solving the problems of small farmers; however, the Symposium has opened the door to the desirability of considering cross-fertilization of the two different types of approaches.

5. There has been, in the past, little communication between those people working on small farm problems in the United States and those working on small farm problems in developing countries. Enough has been said that would appear to justify closer communication and collaboration between those working domestically and internationally. It would appear desirable to encourage increasing transfer of people working on small farm problems in the United States and developing countries; I am very happy to see that Dr. Hagen, who has done so much domestic work on small farm problems, is now doing some international work, while Dr. Hildebrand is now using his earlier international expertise to work on small farm problems in the United States. I personally hope that this transfer will increase. Finally, I also hope that the Symposium will have been the start of an improved dialogue between those working domestically and internationally on small farm problems.

SYMPOSIUM PARTICIPANTS

DUANE ACKER is President of Kansas State University (KSU). He has been Vice Chancellor of Agriculture and Natural Resources at the University of Nebraska-Lincoln; Dean of the College of Agriculture and Biological Sciences, Director of the Agricultural Experiment Station, and Director of the Cooperative Extension Service at South Dakota State University; and Associate Dean of Agriculture, Director of Resident Instruction, and Assistant Director of the Agricultural Experiment Station at KSU. Acker's educational background is in animal science and nutrition. He has traveled extensively in South America, China, the Philippines, and Nigeria.

CHARLES BUSSING is an Assistant Professor of Geography at Kansas State University (KSU) and a Program Associate under the Farming Systems Research component of the University's Title XII Strengthening Grant. He traveled to Latin America recently to study the conditions of small-scale farmers in Guatemala, Costa Rica, and Mexico. Bussing was also a member of the KSU team that carried out the recommendation domain study for the Botswana Agricultural Technology Improvement Project this summer.

JAMES CONVERSE is an Assistant Professor of Sociology, Anthropology, and Social Work at Kansas State University (KSU) and a Program Associate under the Farming Systems Research component of the University's Title XII Strengthening Grant. He was a Consultant for the U.S. Agency for International Development (USAID). on the Social Soundness Analysis Rural Development and Small Rural Industry Handicrafts Project in Guatemala (1977) and a Visiting Professor at the Universidade Federal da Bahia in Brazil (1976). Converse was also a member of the KSU team that carried out the recommendation domain study for the Botswana Agricultural Technology Improvement Project this summer.

CHARLES DEYOE is Head of the Department of Grain Science and Industry, and Director of the Food and Feed Grain Institute and the International Grains Program at Kansas State University. He was an U.S. Agency for International Development (USAID) Consultant on grain science and animal feed needs in India (1971) and a Consultant for the Food and Agriculture Organization (FAO) of the United Nations in Bulgaria on animal feeds and nutrition (1976). Deyoe lectured at a feed milling seminar in Beijing, China and reviewed training programs, equipment needs, and research areas at the Wuxi and Chengchow Institutes in China this year.

JOHN DUNBAR is Dean of Agriculture and Director of the Agricultural Experiment Station at Kansas State University (KSU). He was formerly Director of the Cooperative Extension Service at KSU (1976-80) and Associate Director of the Cooperative Extension Service and the Agricultural Experiment Station at Purdue University. Dunbar has served as a consultant to the National Food and Agricultural Council of the Philippines (1978, 1979, 1980) and as a consultant in Pakistan, Iran, and Turkey.

MARVIN FAUSETT is an Associate Professor and Area Extension Economist at Kansas State University where he adapts, prepares, and presents agricultural economic information for producers in Southeast Kansas and adapts general economic information for small farmers. He worked on a special small farm project sponsored by West Virginia University and The Rockefeller Foundation, which ran from 1970-79.

CORNELIA FLORA is an Associate Professor of Sociology, Anthropology, and Social Work at Kansas State University (KSU) and a Program Associate under the Farming Systems Research component of the University's Title XII Strengthening Grant. She is a consultant for The Ford Foundation's Programs on Women and Development in Latin America and the Caribbean. Flora was Director of KSU's Population Research Laboratory from 1970-80 and has written extensively in this area and in the area of Women and Development. Her travels have taken her to numerous countries, including Mexico, Cuba, Colombia, Ecuador, Brazil, Peru, Argentina, Chile, Venezuela, Uruguay, Nicaragua, Barbados and the Dominican Republic.

JAN FLORA is an Associate Professor of Sociology, Anthropology, and Social Work at Kansas State University and Specialist in Community Research for Kansas Agricultural Experiment Station. As Program Advisor/Consultant for The Ford Foundation, Flora is involved with the development and administration of programs in agriculture, health, and women in Nicaragua. He has also developed and reviewed grants and proposals for The Ford Foundation and InterAmerican Foundation.

CHARLES FRANCIS is an Associate Professor and Sorghum Breeder/Physiologist in the Department of Agronomy at the University of Nebraska. During 1970-77, he held positions on several projects at the International Center for Tropical Agriculture (CIAT) in Colombia—Intercropping Agronomist, Program Leader, and Physiologist on the Bean Program; Program Leader and Agronomist on the Small Farm Systems Program and Program Leader and Breeder on the Maize Program. Francis has consulted with World Bank, the U. S. Agency for International Development (AID), CIAT, and the International Sorghum and Millet Project (INTSORMIL) on breeding, cropping systems, and organization of research and extension systems in Latin America, Africa, and Asia.

PETER HILDEBRAND is a Professor of Food and Resource Economics and Coordinator of the Farming Systems Program at the University of Florida where he is advising the department and the Institute of Food and Agricultural Science on small-farm farming systems programs in other countries; assisting in the design of a multidisciplinary pilot research and extension project of farming systems for Florida agriculture; and establishing an international farming systems training program. During 1974-80, he was responsible for the development of the Socioeconomics Unit for an Instituto de Ciencia y Technologia Agricolas (ICTA) project in Guatemala. Hildebrand was also Head of the Agricultural Economics Department at the Center for Agricultural Technology (CENTA] in El Salvador (1972-74).

J. ARTHUR HOBBS is a Professor of Agronomy and Assistant to the Director of International Agricultural Programs at Kansas State University. He is also a Program Associate under the Farming Systems Research component of the University's Title XII Strengthening Grant. Hobbs has consulted in Sri Lanka (1979) and Tanzania (1979) and was Head of the Department of Soil Science (1964-66, 1970-74) and Dean of Agriculture (1965-66, 1971-72) at Ahmadu Bello University in Zaria, Nigeria.

GLENN JOHNSON is a Professor of Agricultural Economics at Michigan State University (MSU) and President of the International Agricultural Economics Association. He was a member of MSU's advisory group at the University of Nigeria (1962-64); Director of the University of Nigeria's Economic Development Institute (1963-64); and a long-time consultant to the Tennessee Valley Authority. Johnson has been a consultant for the U.S. Department of Agri-

culture (USDA), The Rockefeller Foundation, and several universities, and has served as Director of the Consortium for the Study of Nigerian Rural Development, Agricultural Sector Simulation, and Korean Agricultural Sector Study.

BERL KOCH is a Professor of Animal Sciences and Industry at Kansas State University (KSU) and a Program Associate under the Farming Systems Research component of the University's Title XII Strengthening Grant. He was a consultant on the KSU-Philippines Integrated Agricultural Production and Marketing Project (1978-80) and Head of the Animal Science Department at Ahmadu Bello University in Zaria, Nigeria (1964-66, 1970-72). Koch headed the team of KSU faculty that carried out the recommendation domain study for the Botswana Agricultural Technology Improvement Project this summer.

OWEN KOEPPE is Provost of Kansas State University (KSU). He was Provost of the University of Missouri-Columbia during 1979-80 and Provost for Academic Affairs during 1973-79; he was also Chairman of the University of Missouri's Department of Biochemistry during 1968-73. In 1979, Koeppe received the Distinguished Alumnus Award from Hope College (Michigan). He led a KSU team to Nigeria early this year to serve as consultants to the government of Gongola State.

VERNON LARSON is Director of International Agricultural Programs at Kansas State University (KSU). He was Chief of Party of the KSU/U.S. Agency for International Development (AID) team involved in developing Andhra Pradesh Agricultural University in India (1970-72). Larson was also Kansas State Team leader, Dean of Agriculture, and Professor and Head of Animal Science at Ahmadu Bello University in Zaria, Nigeria (1966-68). In 1959 and 1962, he was Assistant Dean of Agriculture at the American University of Beirut in Lebanon.

ROBERT MCDOWELL is a Professor of International Animal Science at Cornell University where he is responsible for training in International Animal Science to include direction of a network of institutions in ten developing countries that are collaborating with Cornell University. He has held numerous interim faculty appointments in institutions overseas and has served as a consultant to the U.S. Agency for International Development (AID), the Food and Agriculture Organization (FAO) of the United Nations, and other international agencies and foreign governments. McDowell is currently serving as Chairman of the Board of Trustees of the International Livestock Centre for Africa (ILCA) and is a member of the External Evaluation Panel for the Title XII Small Ruminant Program. In 1979, he received the International Animal Agriculture Award from the American Society for Animal Science.

DAVID NORMAN, a British citizen, is a Professor of Agricultural Economics at Kansas State University and Director of the Farming Systems Research component of the University's Title XII Strengthening Grant. His current involvement in farming systems research in various countries stems from eleven years experience working on small farmer problems, first as a staff member and later as Head of the Department of Agricultural Economics and Rural Sociology at the Institute for Agricultural Research at Ahmadu Bello University in Zaria, Nigeria. Norman was recently involved in the preparation of the Project Paper for the Botswana Agricultural Technology Improvement Project and returned from Hyderabad, India, in November, where he was a consultant with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

HUGH POPENOE is a Professor of Soils, Botany, Agronomy, and Geography and Director of International Programs in Agriculture and the Center for Tropical Agriculture at the University of Florida. He is also Director of the State University System of Florida Sea Grant College and Chairman of the Joint Research Committee of the Board for International Food and Agricultural Development (BIFAD). Popenoe has been involved in a number of short-term assignments in Hawaii, Colombia, Costa Rica, Honduras, Jamaica, Nicaragua, Panama, El Salvador, and Vietnam where he evaluated and recommended changes in agricultural colleges and schools.

EDWIN PRICE is an Agricultural Economist at the International Rice Research Institute (IRRI) in the Philippines, presently on leave as a Visiting Fellow at Yale University's Economic Growth Center. At IRRI, he is involved with the Cropping Systems Program and is Chairman of the Economics Committee of the Working Group of the Asian Network for Cropping Systems Research, Price is also a Visiting Associate Professor with the Department of Agricultural Economics at the University of the Philippines,

SEGUNDO SERRANO is a Ministry of Agriculture Regional Director in the Philippines. He was a visitor at the Symposium invited, at the last minute, to give a panel presentation.

FLOYD SMITH is a Professor of Agronomy at Kansas State University (KSU), Executive Director of the Midamerica International Agricultural Consortium (MIAC), and Director of the Kansas Water Resources Research Institute, He has been involved in reviews of the KSU-Philippines Integrated Agricultural Production and Marketing Project (1976, 1981), and executive visits to MIAC projects in Morocco and Tunisia. Since 1978, Smith has been a member of the Foreign Agricultural Service exchange team in the USSR, regarding grain sorghum and corn production.

NORMAN UPHOFF is an Associate Professor of Government at Cornell University and Director of the Rural Development Participants Project, which is under a cooperative agreement between the U.S. Agency for International Development (AID) and the Rural Development Committee of the Center for International Studies at Cornell University; he was Chairman of the Rural Development Committee from 1970-77 and is now Vice Chairman. Uphoff has done research in Ghana and Nigeria and has been working in recent years in Nepal and Sri Lanka. He spent his sabbatical year (1978-79) at the Agrarian Research and Training Institute in Colombo, Sri Lanka and has done consulting work in Liberia and Egypt. His current research focuses on the role of local organization in rural development and on the means of improving water management in large irrigation schemes through increased farmer participation in water user groups.

WARREN VINCENT is a Professor of Agricultural Economics at Michigan State University working in the areas of farm management and development economics. He recently returned from a two-year consultancy on the KSU-Philippines integrated Agricultural Production and Marketing Project where he was part of a team involved in the development, verification, packaging, and dissemination of technologies designed to improve the net income of small farmers. Vincent was also Head of the Agricultural Economics Department on an institution-building project in Nigeria during the mid-1960s and has been on short-term assignments in Thailand, Ethiopia, Argentina, and Korea.

JERRY WEST is a Professor of Agricultural Economics at the University of Missouri working in the area of Agricultural Research Policy and Rural Development. He conducted an evaluation of the Small Farm Extension Program, an outreach effort that utilized paraprofessionals to get technical assistance into the hands of limited resource farmers. West has also been active in national level research and discussion of the structure of the agriculture project launched by former U.S. Secretary of Agriculture Bob Bergland.

L. VAN WITHEE is a Professor of Agronomy at Kansas State University (KSU) and a Program Associate under the Farming Systems Research component of the University's Title XII Strengthening Grant. He was Assistant Dean of Agriculture at Ahmadu Bello University in Zaria, Nigeria (1966-68) and Irrigation Consultant on a project in Brazil (1972). Withee was also a member of the KSU team that carried out the recommendation domain study for the Botswana Agricultural Technology Improvement Project this summer.

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ABBREVIATIONS AND ACRONYMS

AID - Agency for International Development
APROSC - Agricultural Projects Service Centre
BF - Balanced Farming
CGIAR - Consultative Group on International Agricultural Research
CIAT - International Center for Tropical Agriculture (Centro Internacional de Agricultura Tropical)
CIMMYT - International Maize and Wheat Improvement Center (Centro Internacional de Jejoramiento de Maiz y Trigo)
CIP - International Potato Center (Centro Internacional de la Papa)
CSNRD - Consortium for the Study of Nigerian Rural Development
FAO - Food and Agriculture Organization (of the United Nations)
FHD - Farm and Home Development
FmHA - Farmers Home Administration
FS - Farming Systems
FSR - Farming Systems Research
FSR/E - Farming Systems Research/Extension
IBPGR - International Board for Plant Genetic Resources
ICAR - International Centers for Agricultural Research
ICARDA - International Center for Agricultural Research in the Dry Areas
ICRISAT - International Crops Research Institute for the Semi-Arid Tropics
ICTA - Instituto de Ciencia y Technologia Agricolas
IITA - International Institute of Tropical Agriculture
ILCA - International Livestock Centre for Africa
ILRAD - International Laboratory for Research on Animal Diseases
IMS - Interstate Managerial Study
IRRI - International Rice Research Institute
ISNAR - International Service for National Agricultural Research
KSU - Kansas State University
LDC - less developed country
MSU - Michigan State University
NIA - National Irrigation Administration
NRC - National Rural Center
RDC - Rural Development Committee
RNRDP - Rasuwa-Nuwakot Rural Development Project
SFDP - Small Farmer Development Project
TAC - Technical Advisory Committee (of the CGIAR)
TVA - Tennessee Valley Authority
USDA - United States Department of Agriculture
WARDA - West Africa Rice Development Association
WRDC - Western Rural Development Center